



UNITED STATES  
AIR FORCE  
ACADEMY



**CSURF**

Colorado Springs  
Undergraduate Research Forum

**2020**

**Book of USAFA Abstracts**

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# Colorado Springs Undergraduate Research Forum

## Letter from the USAFA Dean of the Faculty

Every facet of our society has been touched by COVID-19, and research is no exception. Every Spring the Air Force Academy partners with our local Colorado Springs schools of higher education to hold the Colorado Springs Undergraduate Research Forum (CSURF). CSURF is a collaborative event designed to highlight the research and creative works of undergraduates from Pikes Peak Community College, Colorado College, the United States Air Force Academy, and the University of Colorado Colorado Springs. Each year the conference rotates between these institutions, and USAFA was scheduled to host the event in 2020.

Due to the pandemic affecting our nation and with the safety of our students, staff and local community in mind, we decided to cancel the 17th Annual CSURF. While the event was cancelled, our students still have research stories to tell. They worked feverously on their research projects for many months, and in some cases years. While we cannot meet in person with our Colorado Springs partners and regular CSURF attendees, we still wanted to share with you the great research accomplishments of our cadets.

In this “virtual CSURF” booklet, please find abstracts summarizing 87 cadet projects from 11 of our academic departments conducted during the 2019/2020 academic year. While I regret that you cannot meet with our incredibly bright and motivated cadets, I hope you will still be inspired by their remarkable undergraduate research. From all of the faculty and staff at the United States Air Force Academy, we wish you health and safety.



**LINELL A. LETENDRE**  
Brigadier General, USAF  
Dean of the Faculty, United States Air Force Academy





# Department of Biology

## Antibiotic Characterization of Marine Algal Extracts

C2C Anne A. Ahlquist, C3C Taryn M. Cates-Beier, C2C Rebekah M. Joy, C2C Alyssa B. Tamburo, and C1C Tyler J. Wright

Faculty Mentor: Dr. Anthony R. Arment

### Abstract:

The objective of this research is to isolate and identify novel anti-bacterial compounds from marine algal extracts. Using disc diffusion assay, a small amount of antibiotic activity was detected for all of the tested extracts. Precipitates were formed using alcohol separation and were re-solvated in H<sub>2</sub>O; antibiotic activity was detected in both the supernatant and the precipitates. Currently, we are using paper chromatography to separate the extracts' components, which will individually be tested for antibiotic activity. For isolated components with antibiotic activity, gas chromatography-mass spectrometry will be used to determine chemical structure, which will reveal if we have a novel antibiotic.

## Genetic Engineering of Cyanobacteria with a GFP Trehalose Biosensor to Visualize Response to Desiccation

C2C Katarina M. Kowar

Faculty Mentors: Melanie L. M. Grogger and Dr. Donald V. Veverka

### Abstract:

Concerns about climate change and desertification have increased research efforts in elucidating cellular mechanisms used by extremophilic microorganisms to survive in hostile environments. The objective of this research is to ascertain whether production of trehalose in certain cyanobacteria correlates with their ability to tolerate desiccation. Researchers have found that some cyanobacterial extremophiles, isolated from desert crusts, are able to survive desiccation by producing trehalose to stabilize cellular structure and protect genetic information. We are developing a genetically engineered biosensor to indicate real-time trehalose production in cyanobacteria under desiccation conditions. Genetic engineering is being used to insert a biosensor, which activates green fluorescent protein (GFP) upon binding of trehalose, into cyanobacterial expression vectors. Protocols for producing electrocompetent cyanobacterial

cells were developed for four different strains with successful transformation of a GFP-expressing plasmid in *Anabaena*. Understanding the mechanisms through which some extremophiles achieve stress tolerance could have profound implications in developing drought resistant crops and stabilizing soils affected by desertification.

### **Bacterial Expression of Tardigrade Damage Suppressor Protein**

**C1C Johnathan W. Ford and C2C Camryn M. Olhausen**

**Faculty Mentor: Dr. J. Jordan Steel**

#### **Abstract:**

The objective of this experiment is to evaluate the potential of the tardigrade protein DSUP to reduce adverse radiation effects in both biological and mechanical contexts. This protein is implicated in the ability of tardigrades to withstand extremely high levels of ionizing radiation. DE3 *Escherichia coli* will be transformed with an expression plasmid containing the DSUP gene. Transformed cells producing DSUP will then be treated with UV light to evaluate their radiation resistance by comparing their survival rates to those of the controls. The protein can then be extracted for further application, to include a topical coating for electronics in order to extend satellite longevity in geocentric orbital environments.

### **Utilizing Falcon Microbiomes to Aid Conservation**

**C1C Kaila L. Baca Faculty**

**Mentor: Erin A. Almand**

#### **Abstract:**

The objective of this study was to survey and compare the gut microbiomes present in six falcon species maintained in the Falconry Program at the United States Air Force Academy. Samples of fecal material provided microbial DNA, which was amplified by PCR for 16S rDNA sequencing. Data will be analyzed for trends related to age, oral medication, and time in captivity in order to draw conclusions about their effect on raptor health. The falconry and conservation communities hope research in raptor gut microbes will improve the health of their birds, allowing better preservation of these apex predators and increasing the success rate of raptors as they are released back into their natural habitat.



## **Bioaccumulation of PFOA in an Ant-Plant-Aphid Mutualism**

**C1C Angela Buch and C1C Ethan Maertz**

**Faculty Mentor: Dr. Kellie Kuhn**

### **Abstract:**

This laboratory experiment exploits an ant-plant-aphid mutualism to assess bioaccumulation of perfluorooctanoic acid (PFOA), an emerging contaminant linked to cancer and other health issues in rodents. Although PFOA has shown the ability to bioaccumulate in flora and fauna in laboratory and field conditions, the ecological effects of PFOA are largely unknown. We hypothesize that if PFOA bioaccumulation occurs in angiosperms by soil contamination in the laboratory, the growth rate of these plants will be reduced and they will act as less suitable hosts for naturally occurring ant-aphid mutualisms. Prairie sunflowers (*Helianthus petiolaris*), radishes (*Raphanus sativus*), and peas (*Pisum sativum*) were reared from seed in the laboratory, dosed with PFOA via contaminated water, and colonized by aphids and ants. Quantitative and behavioral analyses were conducted to determine the amount of bioaccumulation in the plants and higher trophic levels. With an enhanced understanding of the ecological effects of PFOA, better policies can be implemented to protect people and the environment.

## **Bacterial Interspecies Communication and Inhibition: the Effects of *Lactobacillus reuteri* on Different Bacterial Species**

**C2C Meghan S. Carbiener and C2C Ruby P. McKain**

**Faculty Mentor: Dr. Katherine Bates**

### **Abstract:**

The objectives of this study were to characterize the in vitro inhibitory properties of *Lactobacillus reuteri* on *Bacillus atrophaeus*, and to evaluate the effects of the histamine produced by *L. reuteri* on bacterial species found in the small intestine of mammals. *Lactobacillus reuteri* is a probiotic known to produce antimicrobial molecules, such as organic acids, ethanol, reuterin, and can inhibit the colonization of pathogenic microbes. *Lactobacillus reuteri* was co-cultured along with *B. atrophaeus*, a *Bacillus anthracis* proxy, at various distances, and incubated before checking for *B. atrophaeus* inhibition. After isolating *L. reuteri* and inducing it to produce bacterial histamine, tests were conducted to observe the histamine's ability to inhibit the growth of other bacterial species. This research aims to demonstrate that *L. reuteri* may have potential as an alternative to antibiotic use.



## Highly Sensitive and Specific Bioreporters for the Detection of PFAS in Environmental Samples

C2C Alissa M. Till, C3C Conley L. Walters, C3C Olivia M. Orahood, C2C Chris S. Jeon, C3C Nick D. Garbinski

Faculty Mentors: Dr. Anthony R. Arment, Dr. Erin A. Almand, Dr. J. Jordan Steel, and CPT John C. Sitko

### Abstract:

Microbial bio-reporters offer an excellent form of detection for known biochemical contaminants and pollutants within our environment. Detection methods for Per and polyfluoroalkyl substances (PFAS) utilizing current laboratories and technological equipment are costly, time consuming, and limited. Previous research identified *prmA*, a stress response gene that was elevated three-fold in the presence of PFAS. Although successful, this modest increase in gene expression may not be robust enough for wide application in a field setting. To find potential genes upregulated in the presence of contaminants, bacteria were isolated from highly contaminated PFAS locations. Shotgun genomics will be used to find a potentially more effective PFAS-inducible promoter. Alternatively, due to the recent synthesis and introduction of PFAS contamination, there may not be a naturally occurring PFAS response pathway in microbes. To overcome this potential shortfall, aptamers will be made to specifically target environmental PFAS molecules. This novel approach does not rely on identifying and adapting an existing mechanism, potentially increasing the specificity and response. This combined approach increases the opportunity for identifying a detection method capable of rapid, field detection for PFAS contamination.





## **Eliminating PFAS: Biological Degradation of Perfluorinated Compounds**

**Authors:** C2C Jackson D. Harris, C2C Thuytien Pham, C3C Megan E. Doherty, C2C Brian Swicegood, C3C Abbie E. Loesch

**Faculty Mentors:** CPT John C. Sitko, Dr. Erin A. Almand, Dr. J. Jordan Steel, and Dr. Anthony R. Arment

### **Abstract:**

Perfluorinated alkyl substances (PFAS) are stable compounds that persist in the environment, contaminating water and accumulating to potentially harmful levels. An efficient degradation method to remove this contaminant has not been identified. Despite the potentially harmful effects, plants uptake high amounts of PFAS into their systems. Many of these plants, including members of the mustard family, contain peroxidase, which may be able to degrade PFAS. To investigate in vitro, a biochemical process utilizing catalyzed peroxide and radical chemistry mimicking peroxidase activity are being conducted. Like plants, bacteria are often found in areas with PFAS contaminated soil. To investigate existing degradation properties in these microorganisms, contaminated soil was obtained, and bacteria are being screened to determine if PFAS could be used as a sole carbon source. If a microorganism survives when fed only these compounds, likely some chemical degradation is being performed. In addition to targeting whole microorganisms, it may be possible to identify genes involved in a PFAS response and use bioengineering to design a system that can efficiently remove PFAS from contaminated environmental samples. This multifaceted approach to PFAS degradation provides multiple avenues of experimentation to potentially deal with this harmful and ubiquitous contaminant.

## **Targeted Phage Probiotics: Development of a Recombinant Lactobacillus to Secrete Lysin**

**C2C** Annelise N. Holland, **C2C** Peter G. Lochmaier, **C3C** Eamon A. McHugh, **C2C** Meaghan T. Raab, **C2C** Maddie M. Reicher

**Faculty Mentors:** Dr. Anthony R. Arment, CPT John C. Sitko, Dr. J. Jordan Steel, Dr. Erin A. Almand

### **Abstract:**

Gastrointestinal infection and disease, commonly referred to as “traveler’s diarrhea”, is a prominent health concern for an increasingly mobile population. Currently, there is not a reliable preventative therapy for these ailments, forcing healthcare providers to rely on antibiotics after infection. Previously, clinicians utilized probiotic bacterial strains to prevent and treat gastrointestinal infections and diseases, however, while these helpful microbes may be able to colonize the gastrointestinal tract, they may be out-competed by pathogenic bacteria. Lysin proteins target peptidoglycan in the bacterial cell wall, causing them to rupture, and



ultimately clear in vivo infections. However, lysins, like antibiotics are a treatment rather than a preventative measure. We propose the creation of a more effective preventative therapy for gastrointestinal infections and disease is possible through engineered targeting of the combined efficacy of probiotics and lysins. Our current research seeks to engineer a common probiotic, *Lactobacillus plantarum*, to manufacture and secrete a lysin targeting *Staphylococcus aureus*, a common foodborne-pathogen. The first, proof-of-concept, experiments engineer *L. plantarum* to secrete green fluorescent protein (GFP), to ensure the construct and secretion signals are viable. Following these initial tests, the secretion signal will be fused to the lysin protein, and additional studies will be carried out to determine if the lysin is being secreted, how much is being secreted, and if this secreted lysin is an effective deterrent to *S. aureus* growth.





# Department of Civil and Environmental Engineering

## Field Demonstration of Colloidal Silica Concrete Pavement C2C Eric Long and C2C Clay Madson

### Abstract:

Upkeep of airfield pavements is of critical importance to Air Force civil engineers. Deteriorating airfield pavements create a severe risk to the Air Force's ability to execute aircraft missions safely and effectively. Due to the large dynamic loading on airfield pavements and the potential deterioration due to chemical and physical factors, both airfield pavement strength and durability are of utmost importance. A Colorado company, Intelligent Concrete, has developed a colloidal silica Portland cement concrete that can improve airfield pavement strength and durability. For this research project, cadets from the United States Air Force Academy will work with Intelligent Concrete to test their colloidal silica concrete. The team will create a mix design, then perform required laboratory tests including compressive strength of cylinders, flexural strength, resistance to rapid freezing and thawing, and abrasion resistance. Additionally, cadets will assist in placing multiple concrete slabs at the United States Air Force Academy's Field Engineering and Readiness Laboratory (FERL) site. These concrete slabs will include strain gauges and serve as a field demonstration of the colloidal silica concrete pavement. The FERL site will allow a controlled traffic environment that can include normal automobile traffic as well as heavy construction equipment traffic. Data will be collected on the field demonstration pads to show if the desired increase in strength and durability is achieved. The field demonstration pads will be placed in April 2020 and will be monitored through June and potentially into the fall of 2020. The desired outcome is to demonstrate to the Air Force the viability of a colloidal silica concrete pavement with adequate strength and improved durability that can be used on airfields.





# Department of Computer and Cyber Sciences

## Cyber Exercise

C1C Bailey Compton and C1C Katherine Scheibner

Faculty Mentor: Lt Col Cynthia Brothers and Dr. Joel Coffman

### Abstract:

Military training environments, such as Red Flag, lack sufficient tools to model real-time cyberspace threats and capabilities. As a result, training for today's multidomain and joint nature of warfare is inadequate, causing cyberspace operations to be misunderstood and misused in the conflict environment. To better prepare cyber operators- and military professionals in general- to accomplish the mission in the increasingly complex warfare environment, the team seeks to develop a tool to educate such individuals on cyber capabilities and threats. The team's approach is to map realistic enterprise and DoD networks, using data points such as number of users, number of nodes, attacker persistence, password security, and more, from these networks to run Monte Carlo simulations that evaluate the average "time to infiltration" of their defenses. From these results, the team can approximate the probability that a Department of Defense cyberspace asset will be compromised, given a threat landscape. These probabilities can be compiled to make a tool known as a "Probability of Kill" matrix, which succinctly approximates for both cyberspace and non-cyberspace system operators the cyber-based threat to air, space, and cyberspace assets in the training environment. Ultimately, the Cyber Probability of Kill matrix will promote better joint and multi-domain training for military forces.

## Defending Democracy in Cyberspace

C1C Katherine Scheibner

Faculty Mentor: Lt Col Cynthia Brothers and Dr. Joel Coffman

### Abstract:

On November 3rd, 2020, millions of Americans will head to their local polling stations to participate in the event most symbolic of our democracy: the presidential election. The presidential election demonstrates both great power and trust, empowering the American people to have a say in their governance, while demonstrating and reinforcing the people's faith that the government will protect, value, and honor their will. However, the presidential election also draws attention to a major issue facing democracies around the world. As many of the activities surrounding democratic elections, from campaign advertisement, to voter registration, to vote casting and

counting, increasingly take place electronically, states are struggling to safeguard the integrity of democratic elections from the growing number and diversity of cyberspace threats, both domestic and international. This research analyzes election security methods and concerns in both the United States and India, exploring the nature of cyberspace threats to democratic election processes and highlighting how differences in political culture can create unique challenges for different states. India is an ideal state to use as a comparison for the United States because since 2004, the use of Electronic Voting Machines (EVMs) has been standard throughout India. Furthermore, India is a constitutional republic with 29 states, 7 territories, and 1.3 billion people, making it a large democratic state that is comparable in complexity to the United States.

### **Automated Electromagnetic Emissions Tracking**

**C1C Sears Schultz, C1C Dallas Huff, and C1C Tony Giaimo**

#### **Abstract:**

The 453rd Electronic Warfare Squadron collects electromagnetic emissions from around the globe. The data is used to identify the location and type of potential adversary radar. However, the process for interpreting the data is currently a manual and time intensive process. The Air Force's mission capability could increase significantly if radar location and type identification were automated. The goal of this project is, given real time electromagnetic emission data input, display a heat map that displays the likely location of radar. We have developed an algorithm that uses artificial intelligence, specifically a hidden Markov model, to determine the location of potential radar. The algorithm tracks radar as they move and remembers previous radar. It takes into account multiple features, such as the location of the electromagnetic emissions and their intersections. To assist in testing and training the algorithm, data analysis was completed to allow for the simulation of more data. The final product interfaces with a SQL database to pull emissions data and output results of the algorithm.

### **Mixed Reality Post-Flight Debrief**

**C1C Evan Gabrielsen, C1C Jacob Dimmit, C1C Helen Landwehr, C1C Joe Laniado**

#### **Abstract:**

Taking advantage of emerging technologies in the virtual and augmented reality industry, this project utilizes Microsoft's Mixed Reality Hololens platform to create a post-flight debriefing tool for U.S. military pilots. Wearing the Hololens headset, the user is presented with a holographic projection of the terrain over which his or her sortie was flown. The pilot, along with anyone else wearing a headset, can then



replay the sortie at various speeds to analyze flight patterns, maneuvers, and enemy behaviors. The flight data for the review is pulled directly from the aircraft's flight recording system and will enable the program to accurately recreate pitch, roll, yaw, velocity, and location. Expanding on the idea of an inclusive debriefing mechanism, the MRPFD will enable reviewers located in remote locations to join in on the debrief and watch the sortie replayed along with the rest of the flight crew. This way, if a general in Washington DC wants to be able to see the outcome of a mission in Afghanistan he will be able to do so from the comfort of his office while wearing one of the Hololens headsets. The goal is that the MRPFD will replace the current method of flight debriefing involving model planes on a handheld stick and physical maps. Possible applications include use as an educational tool in flight training squadrons as well as an asset in deployed combat operations for real life missions.

### **PNT Capstone Abstract**

**C1C Will Hanlen, C1CTim Santos, and C1C Kishan Patel**

#### **Abstract:**

As the US military shifts from fighting terrorists to fighting near peers, the battlefield landscape changes. Near peer adversaries will attack our navigation satellites and jam GPS frequencies. In that event, we need redundant navigation methods which enable operators to do their job unhindered. Our capstone project is to build a navigation app for the 10th Special Forces Group that alleviates the problem of GPS denial and degradation. The app's UI must be structured for the stressful environments of Special Forces warfare. The app must navigate in GPS denied areas using alternate locating methods such as WIFI and Cellular towers. The app must conceal its user interface so operators can navigate without conspicuously looking at a map app. The app must maintain operation security by obscuring or obfuscating transmitted data. We accomplish this by manipulating the cellphone's navigation features. Every modern smartphone in the world is constantly receiving signals from nearby cell towers, Bluetooth devices, and WIFI routers - even if it is not connected to them. We can use these signals to determine our location. This works by doing a database lookup on the device ID broadcasted by the cell towers and WIFI routers. The database will return the last known location of the broadcasting device. Locations are fed into user interface so users can see their location as well as the locating method used to find it.

## **LiFi Capstone**

**C1C Kyle Kauffman, C1C Matthew Kuhn, and C1C Sierra Ernst**

### **Abstract:**

Our senior year capstone objective is to assess the current state of Light Based Communication and analyze potential, future military use cases. Our exploration of these topics began with a proof of concept, light-based wireless speaker. Using this project as a jumping off point, the team began studying premier consumer LiFi technology, a light based approach to wireless internet, produced by the company PureLiFi. This study involved numerous tests of the technology's capabilities, testing operation angles, distances, and reflection. Following these tests, we began research into current military use cases which include the use of light communication in classified facilities and in medical tents and operating rooms as a means to communicate in a radio frequency sensitive environment. Further, we completed an exploration of future military use cases through another proof of concept for transmitting arbitrary data using cheap, commodity technology. This proof of concept was developed using two Arduinos and some LEDs. Such a device may be useful for covert data exfiltration using non-radio frequency (rf) signals or in drone-to-drone communication in rf denied environments.

## **Development of a Fully Autonomous Air-to-Air Combat System without a Central Control**

**C1C Andrew Christensen, C1C Joseph Crisostomo, and C1C Maxwell Turner**

### **Abstract:**

The conducted research attempted to develop a system of autonomous airborne fixed-wing drones that worked cohesively together as a single swarm. Having each individual unit make decisions without the assistance of another unit or a control unit from the ground and without a command structure was of particular interest. Research was done in a virtual simulation through the use of Advanced Framework for Simulation Integration and Modeling (AFSIM). Initial research was done using traditional algorithms for behavior such as Djikstra's and Flocking Behaviour. Further research has been conducted using machine learning, specifically a variation of AlphaZero's deep learning machine and implementing RLib from the python machine learning suit. (We have no results yet so not discussed now)



## **Self-Healing Drone Swarm**

**C1C Andrew Weiss, C1C Dean Bartschi, C1C Grace Blagetti, and C1C Alex Knight**

### **Abstract:**

The goal of this project was to create a self-healing drone swarm that could provide persistent cellular coverage to first responders in degraded environments (i.e after natural disasters). This project builds off the work of our predecessors; Chen, Buzzell, Ray, Stanley, and Guerrero. Before physical testing could be accomplished, first a simulation of how the user would deploy the swarm and how the swarm would behave had to be simulated. This project's focus was building the user interface to enter the swarm information, a backend to implement the scheduling algorithm, and then the detached simulation to display how the scheduling algorithm actually controlled the swarm's behavior. The scheduling algorithm is based off of Scheduling Spare Drones for Persistent Task Performance under Energy Constraints by Hartuv, Agmon, and Kraus. This algorithm calculates the number of spare drones required for constant coverage while switching drones for recharging and a strategy for drone replacement.

## **USTRANSCOM Capstone Team Project**

**C1C Claar, C1C Dang, C1C Gwozdz, and C1C Seazzu**

### **Abstract:**

In order to remain atop of the international cyber community the US military must, at all levels, test, probe, and evaluate the security of all cyber systems. USTRANSCOM and the USAFA Cadet Wing are no different. Being a combatant command, USTRANSCOM has ubiquitous networks that are constantly under attack by nation-state, and criminal actors. This year the DFCS/USTRANSCOM Capstone Team targeted outward facing network interfaces, and cloud infrastructure. Moderate information was gained from reconnaissance, scans, and probes on USTRANSCOM infrastructure. From this the team was able to identify several possible threats to USTRANSCOM. Following these efforts, the team shifted to targeting cloud infrastructure. With the migration of major USTRANSCOM resources to the cloud, testing must be conducted to ensure data confidentiality, integrity, and availability. In order to test techniques, capabilities, and results, the team also executed a targeted phishing exercise against the Cadet Wing. From this attack, the information will be used to create a phishing campaign against USTRANSCOM, expected to take place in the fall of 2020. The exercise against the Cadet Wing included false emails, false websites, false databases, and an analysis of password complexity and security of cadets. This work shows how well mandated cyber training effects the actual security of individuals. The Cadet Wing, being the premier officer development program in the Air Force, and USTRANSCOM, being a combatant command, are both strategically important for the United States. These organizations must have robust cyber security and must test these securities regularly. These are just two tests in a continuously improving cadet capstone project.



## Exploring Robotics and Coding with Elementary School Children

C1C Maya Slavin, C1C Heath Hilton, C1C Dominic Buraglio, and C1C Rodney Adams

Faculty Mentors: Dr. Steve Hadfield, Marissa Hadfield, Becky Moulden, and Dr. Steve Fulton

### Abstract:

Introducing children to robotics and computer programming early and with age-appropriate activities and challenges help them to become STEM (Science, Technology, Engineering, and Math) cognizant and can motivate further interest in STEM studies. This Software Engineering capstone effort developed and employed new capabilities for the NAO, Pepper, and Misty II robots for use with elementary school students. The developed capabilities included Reader's Theater robot participation, interactive games, coordinated dances, face and emotion recognition, student programming challenges, creation of a new Blockly-based programming environment, and remote control mechanisms using computers and tablet devices. Engagements with local elementary school students helped to refine the capabilities and gain insights into the students' impressions of the robotics and computer programming.





# Department of Electrical and Computer Engineering

**Assistive Technology**

**C1C Shelby Andrade**

## **Abstract:**

Unlike normally functioning humans, tetraplegics are unable to regulate their body temperature automatically, even in ambient temperatures; therefore, they need an outside source to reduce their core temperature. Tetraplegia is a form of paralysis resulting in partial or total loss of all four limbs and torso, due to illness or spinal cord injury. As such, this injury or illness blocks the communication between the body and the brain. Due to this loss of communication, the person loses the feedback mechanism between their torso and limbs, which inhibits thermoregulation. Thermoregulation is the body's ability to maintain the core body temperature in various ambient temperatures. Therefore, tetraplegics do not have an automatic response, like sweating, and are at risk of heat stroke or hypothermia during even short periods outside in extreme temperatures. FRO-zone (Fully Refrigerated Operational-zone) attempts to solve this issue by creating a user-friendly, transportable, affordable, highly persistent, and safe core body cooling system. This cooling system will be user-controlled, less conspicuous than current solutions, and would monitor the user's body temperature, ambient temperature, and blood pressure. The ultimate goal and key performance parameter of the cooling system is to keep the user's core body temperature within a normal, healthy range. This cooling system will enable the user to extend the safety period for remaining in a hot or cold environment, which can reduce the stress of trying to find air conditioning or shade, or even save their life.

## **Ground-Air Robot Teaming Abstract**

**C1C Irene Liew Faculty Mentor: Capt Steven Beyer**

## **Abstract:**

The objective of the Ground-Air Robot Teaming project is to provide a proof of concept for a semi-autonomous ground-air robot teaming system that can identify and track targets in a potentially hostile environment. The final version of the project is to provide a swarm of aerial drones to semi-autonomously navigate an area and find a target. The drones will then send the target locations to ground vehicles, which will autonomously navigate to and capture imagery of the targets. The ground vehicle will then send imagery of the target to a remote operator. The goal of this project is to provide an indoor model of the Ground-Air Robot Teaming system in which (1) four aerial drones simultaneously 'search' a user-defined area, (2) hover over simulated target coordinates (3) send target coordinates to a ground robot, and (4) the ground robot

receives these coordinates and autonomously navigates to them. This indoor model demonstrates feasibility for multiple aerial drones and a ground robot to coordinate a simulated search effort. Future work on this project involves scaling this indoor system to outdoor deployed scenarios. Robotics Operating System (ROS) is used for communication between systems and provides for both scalability and flexibility in regards to the types of end systems. The use of ROS ensures that the aerial drone platforms can be replaced with outdoor-suitable platforms that use satellite GPS instead of indoor radio communications. Additionally, the ground vehicle uses edge computing to facilitate transition from an indoor navigation system to satellite GPS.

### **Cyber Defense of Robust Microgrid Power Systems**

**C1C Dustin Priaulx, C1C Brett Martin, and C1C Julian Flores**

**Faculty Mentor: Dr. Glen Dudevoir, Lt Col Rebecca Breiding, and Dr. John Ciezki**

#### **Abstract:**

Modern cyber threats pose a real risk to Air Force operations worldwide. One significant aspect of our infrastructure that demands one hundred percent integrity of data, and thus requires a robust line of defense against such threats is our industrial control and power systems. Without proper security against enemy actors in both the physical and cyber domains, nearly every facet of Air Force operations can be brought to a grinding halt. Without power, almost no Air Force asset can work: our Early Warning Defense Systems, our cyber capabilities, our C2 centers. Events involving attacks on power systems have already occurred in other parts of the world such as the cyber-attack that crippled three of Ukraine's power control systems in 2015. The goal of the U.S. Air Force Academy Cyber Power capstone team is to provide solutions to such vulnerabilities across several points of entry and against various means of exploitation. To this end, solutions must involve hardening physical defenses within our own microgrid as well as providing integrity for the data being transmitted between networked nodes. In order to accomplish this, research has been focused on three main tasks. First, we are creating a scaled testbed that accurately models a local power grid in terms of scaled measurements and robust relay settings. Having a strong protection scheme in place will ensure breakers trip quickly and properly redirect power to maintain continuous service to as many users as possible. Second, we are developing a load, controlled by Simulink, which can consume given values of real and reactive power using phase lock loop to add reactive power. This load can add the capability of testing our grid's resiliency. Lastly, a variation of Swirld's Hashgraph algorithm will be implemented on each relay within the microgrid to ensure that the data being received by the Real-Time Automation Controller (RTAC) is accurate. By using Byzantine Fault Tolerance, the Hashgraph algorithm will provide a fast and reliable means to automatically maintain integrity of data by correcting faulty or spoofed data across the entire testbed and will report any anomalies to a central administrator console. Future research would focus on penetration testing to find any additional physical



or cyber vulnerabilities and patch them. Additional research envisions testing other means of communication between geographically isolated network nodes by use of HF communication to simulate alternatives in the case of an internet outage.

### **Falcon Gaze Detection System**

**C3C Allyson Burba and C1C Michael Geraghty**

**Faculty Mentor: Col Brian Neff**

#### **Abstract:**

The motivation for this project was to create a more accessible method of controlling a wheelchair for paraplegics and severe tetraplegics. In particular, we aimed to create a low-cost gaze detection system that would interface through a joystick port on a nuMotion wheel chair for those with severe mobility restrictions. While there are numerous gaze detection systems on the commercial market, available systems are expensive and computationally expensive to employ. This effort focused on using low-cost light weight computing components in conjunction with optimized computer vision algorithms. The entire system was built for less than \$150 which is about 30-times cheaper than the closest commercially available solution. The emphasis behind trying to make the mobility device gaze controlled, was to add an easier / optimized interface for those with limited use of their hands. Additionally, from a military perspective, as systems become more complex, finding alternative ways to interface and provide inputs is not only desirable, but will likely become mission critical in the future. A primary emphasis behind this effort was also to lay the groundwork for future, non-invasive sensor and control integrations into the nuMotion mobility device. Hooks have been provided for the sensors required for autonomous motion, and obstacle avoidance with the chair. An inherent advantage of this system was that the chair movements essentially followed wherever the user looked. However, future work will focus on providing the user the ability to provide inputs with their eyes while simultaneously retaining the freedom to look in other directions.

## Disabling UAVs Electronic Warfare

C1C Katherine Emanuel, C1C Troy Slatkavitz, and  
C1C Charles Wasz

### Abstract:

USAFA's ECE Electronic Warfare Capstone is a second-year research project whereby cadets investigate and exploit radio frequency (RF) vulnerabilities within both commercial and hobbyist unmanned aerial vehicles (UAVs) in order to disable them or significantly degrade system operations. This research aligns with the following objective listed in the April 2019 U.S. Air Force Science and Technology Strategy: develop and deliver transformational strategic capabilities. This "drone-killing" technology is intended to be a realistic and deployable attack method that can target swarms of low-cost, easily assembled hobbyist UAVs, as well as commercial UAVs, in order to combat U.S. adversaries' rapidly developing UAV implementation. It is important to note that our implementation of electronic warfare is not jamming, but instead uses RF to disrupt specific UAV subsystems and device components. Over the last two semesters, the current design team recreated the successes from last year's project and optimized their results. The current team disabled a DJI Flame Wheel and a DARPA Fixed Wing UAV by targeting onboard Spektrum DSMX receivers and PixHawk PX4 flight controllers, changing the motor speed of a DJI 420 Lite electronic speed controller (ESC), and causing an Emax Magnum Mini F4 inertial measurement unit (IMU) in the near-field to falsely register changes in motion while actually lying completely still. These disruptions were caused by the following RF inputs:  $f_c = 2.100\text{GHz}$  and  $f_m = 333.3\text{Hz}$  pulse with a 56.66% duty cycle (DSMX Receiver);  $f_c = 1.581\text{GHz}$  and  $f_m = 400\text{Hz}$  pulse with a 72.80% duty cycle (ESC);  $f_c = 2.002\text{GHz}$  and  $f_m = 31.115\text{kHz} - 31.228\text{kHz}$  pulse with a 50% duty cycle (IMU). Following the advanced characterization of these effects, the design team found additional susceptibilities to include flipping bits in an Arduino after radiating it in the low frequency (LF) band using a 500,000V tesla coil and determined that the IMU could not be disrupted in the far-field. The team has also programmed a SynthHD WindFreak Microwave Generator to independently cycle through various carrier and modulation frequencies in order to automate RF power output in a portable format. The team has modified the WindFreak's original Python script to now be Linux compatible. The Capstone team is currently working to build a "kill drone" platform using the WindFreak, a power amplifier, a Raspberry Pi 4, and a dipole antenna array. In the process of developing this platform, the group has discovered that 2.1GHz is effective not only on the Spektrum DSMX receiver connected to a PixHawk PX4, but also when connected to a PixHawk Mini. Furthermore, this technique is effective on a Spektrum AR7700 receiver and any combination of those flight controllers and receivers. Additionally, 2.1GHz has been found to be effective at disrupting a DJI Phantom 4 and 3DR UAV. In conclusion, the design team has proven that it is possible to disrupt UAVs without jamming them, thereby paving the way for disabling completely autonomous UAVs in the future.



## Beyond LOS Detection of Hypersonic Vehicles

C2C Emily Conroe

Faculty Mentor: Dr. Randall Musselman

### Abstract:

The current line of research is to investigate the use of a passive bi-static over-the-horizon-radar (OTHR), to detect and track a hypersonic vehicle well beyond line of sight (LOS). Bi-static OTHR makes use of two different antennas sites that are not collocated, one serving as the transmitter and the other as the receiver. The proposed transmitter is a commercial shortwave radio station operating in the (“high-frequency”) HF band. As with shortwave radio, OTHR relies on radio waves refracting in the Earth’s ionosphere and returning to earth beyond LOS, i.e., over the horizon. The hypersonic vehicle that will be observed is an Antares 230 rocket launching from Wallops Island, on the NG-14 mission to resupply the International Space Station. Immediately after launch, the rocket will be in the Doppler null of the transmit/receive path, rendering radar ineffective. However, within seconds the rocket will exit the Doppler null and become visible to the receiver. As the earth is currently in an 11-year solar minimum, the lower HF signals will refract at an altitude of only 100km before returning to earth. This is at the bottom of the E-layer of the ionosphere. The Antares rocket will exceed this altitude approximately 250km downrange from the launch site. At this range, the rocket will still be within LOS. However, this proof of concept will motivate the use of higher HF frequencies, where refraction will occur in the F-layer, well above the ISS orbit. It is expected that the rocket will be detected along its path for up to 2000 km, which is well beyond LOS. The primary focus of this research was to predict the expected signal-to-noise (SNR) of the signal as it refracts in the ionosphere, reflects from the rocket, refracts again on its return path, and is received, in the presence of unwanted radio noise. This unwanted noise is primarily generated externally, in the form of galactic noise, thunderstorms, and man-made noise. Furthermore, the SNR is enhanced while in flight, due to the plasma plume that will surround the hypersonic rocket, as it exceeds approximately Mach 6. The rocket will exceed Mach 13, as it enters its initial orbit. Since the geometry of this conductive plasma plume changes with speed, its RCS will continue to change. Modeling and simulation results indicate that the RCS will increase by over a factor of ten, as this plasma plume forms.



## Drone Tracking

C1C Hunter Hayden, C1C Isaac Nicholson, C1C Ludvig Oliver, and C1C Allison Raines

### Abstract:

The purpose of this senior capstone is to create a drone tracking system. With the inception of Light-weight Unmanned Aerial Vehicles (UAVs), security of different assets all around the world can be called into question. This is because some people may desire to harm or do reconnaissance on our assets. As a result, the need for a system to track and identify any unknown object in a specific airspace is necessary. Therefore, we are creating a drone tracking system that will be able to detect and track a drone, nefarious or otherwise, that flies in a specified airspace. One of our main concerns is creating an affordable option that is easy to repair if broken, follows rules and regulations that the US has created in regards to drone use, and uses as many commercial off the shelf parts as possible. The system is made up of components such as a radar, acoustic pods, and a discovery drone with an image processing component. The radar will act as an early detection system letting the user know when an object is in our airspace. Next, the acoustic pods will detect and identify what and where an object is in our airspace based off of certain frequencies that a drone produces. In addition triangulation from multiple pods will help with tracing as well. Lastly, a discovery drone with image processing capabilities will fly to the location of the object and send images to the user so that the user can confirm the identification of the detected object. For the user to be in the loop, a Graphical User Interface (GUI) has been created. Not only will this allow the user to confirm identification, but it can also be used to keep the user informed of the statuses of the different subsystems.





# Department of English and Fine Arts

Private Fortune Wright

C1C Manzi Masozera

## Abstract:

On October 23, 1865, six months after the end of the Civil War, a black soldier by the name of Private Fortune Wright and fellow soldier Private Sherry Fournette were walking down Levee Street in the town of Carrollton, Louisiana, when a seemingly inebriated woman approached Wright and asked him for a dime. It was nearing the evening and upset with this approach he refused to give her any money and informed her that he had a wife and all of his money went to her. The woman berated Wright with slurs and he responded by saying that if she repeated those words to him he would slap her. Testing his patience, the woman repeated what she said and inevitably he responded with a slap. Turning around the corner almost immediately were two men later identified as Dr. Octavius Trezevant and Judge William Scott. These gentlemen saw Wright slap the woman and began spewing hateful words at Wright, both unaware of the events that led to the altercation between him and the woman. Trezevant began to beat Wright with his cane administering several blows. As the fight continued, Scott, egging Trezevant on, insisted that Trezevant kill Wright; and fearing for his life, Wright informed the men that if they jumped on him, he would stab one of them with his knife. Shortly thereafter in an act of self-defense, Wright stabbed Trezevant and was arrested and taken to the Carrollton jail. Trezevant died a few days later succumbing to the stab wound and Wright's life rested in the hands of the court. Sadly, after months of deliberations, on March 2, 1866, Wright was hung in front of an audience of several thousand until he was pronounced dead. At the National Archives, such stories like this exist - roughly 41 to be exact as there are many cases of black Union Army soldiers who were court martialed and executed for various offenses. In an attempt to uncover a chapter in American history that is seldom discussed, this capstone presents the story of Private Fortune Wright, a soldier whose story is actually more sophisticated than meets the eye. Through a long introduction and a series of 10 poems, this capstone seeks to tell the story of a soldier that has been unknown for 165 years and make the case for why stories like his should never be forgotten.

## **What is Really Lurking Underneath the Ocean? Uncovering Humanity's Subconscious through the Exploration the Ecogothic**

**C1C Sarah Schwartz**

### **Abstract:**

Howard Phillips Lovecraft (1890-1937) is generally regarded as one of the finest American authors of weird, horror, and science fiction. However, his work has received little attention from critics over the years. Despite this fact, his work stems from a long tradition of American gothic writing, and forms a cornerstone of twentieth-century interrogations in the ecological gothic or "ecogothic." In order to better understand Lovecraft's approach to literature, it is crucial to begin with earlier American gothic works by authors like Edgar Allan Poe, who formed the basis for the genre through his poems and short stories. This essay begins with Poe and then takes three of Lovecraft's works, "The Call of Cthulhu," "Dagon," and "The Shadow Over Innsmouth" and explores how Lovecraft frames a relationship between individual human mental faculties and the ecogothic. In particular, I will explore the way that Lovecraft represents human consciousness through the liquid element of the ecogothic. In conversation with Lovecraft's works, I also include an analysis of Sigmund Freud's exploration of the phenomena known as "The Uncanny." I argue that the ecogothic, as represented by water, illustrates the regression of the human mind therefore, labeling humans as subservient to the greater environment. In correlation with the oceanic environment, Lovecraft introduces his own mythological creatures, born from water and representative of the cyclical nature of man. Individuals are unconsciously aware of their lack of power in the face of nature, yet Poe and Lovecraft are making this explicit through their narrative techniques. The vision they project is not anthropocentric, but emphasizes the fact that humans cannot overcome nature even though the industrial revolution makes us think otherwise. Lovecraft's stories pose an interesting point of view regarding human life and its existence in the world. Humans search for the truth, but they are unsettled by it when it is discovered. Truth is much like Lovecraft's creatures lurking in the depths of the ocean, it is unknown and difficult to comprehend. By setting his stories around the basis of water, Lovecraft has developed the idea that the human mind is like the ocean: secretive, vast, and incomprehensible.

## **A Morally Culpable Villain: Framing Antagonists in Joker and The Irishman**

**C2C Jordan Brown**

### **Abstract:**

When Todd Phillips' *Joker* released in the fall of 2019, millions of viewers across the world came away from their theatres both appalled and intrigued by the violent and politicized piece they had just witnessed. Joaquin Phoenix's portrayal of the psychologically disturbed Arthur Fleck—the self-proclaimed "Joker"—is one of the most vivid antagonist perspectives released in film in the



last decade. Arthur Fleck is a murderer, at first out of self-defense, but as the movie progresses, his motivations and mental psyche degrade until he kills simply for revenge of personal injury. The purpose of this antagonist perspective, like most antagonist perspectives, is to highlight behavior which is immoral while also eliciting empathy which creates an understanding for the motives behind these heinous individuals. Todd Phillips himself noted of Joker that “It’s not a call to action. If anything it’s a call to self-reflection to society” when responding to remarks about the possibility of copycat violence inspired by Joker (Hagan). Yet, Phillip’s movie has largely been condemned for failing to elicit this self-reflection. The critic David Ehrlich writes that “It’s a confused and self-negating approach to a movie that sees personal revenge as a viable spark for political revolution, and a profoundly dangerous approach to a movie that’s too self-impressed by its own subversiveness to see Arthur as anything but a hero” (Ehrlich). And Glen Weldon of NPR says that the movies that inspired Joker, such as Martin Scorsese’s films, “implicated us in their onscreen violence, in the bad choices their characters made,” while Joker does not (Weldon). Phillips, by many accounts, fails to master the antagonist perspective, and does not properly frame Arthur Fleck in a way which implicate the viewer and inspire self-reflection. In this paper I analyze the framing of the Joker in Phillips’s film, and compare this framing with the successful antagonist perspectives of Martin Scorsese, particularly that of his 2019 film *The Irishman*. By comparing these two works, I explore how an antagonist can be used to implicate the viewer with the immoral acts of an ethically base person, and investigate the narrative and cinematic techniques which properly frame the immoral perspective. Through this I look more broadly at the technique of assigning moral culpability in film and how that culpability is key to creating a character which can both be empathized with but not championed for their misdeeds.

## **Dickinson’s Perspective on Military Death**

**C2C Christian Barrette**

### **Abstract:**

Dickinson’s interesting perspective on military death in the middle of a momentous war offers us a new perspective that we, as a nation, could learn from. In the bloodiest war in our country’s short history, one of the greatest poets of her time was able to find a positive way to cope with death. Dickinson’s description of death as “brave” and artistic can help people mourning their own loved one’s loss of life as it helped her. As a future military officer and the leader of men and women who may have to give their life in defense of this country, it is more essential than ever to value one’s life from the artistic side and remind yourself that casualties are more than just a number. With the current focus on STEM majors and measurable outcomes, paired with a decline in the importance placed on the humanities, the worth of life seems to be lost more often than not. In fact, not once as a cadet at the United States Air Force Academy have we been briefed about healthy coping mechanisms to manage the aftermath of a death, other

than by suicide. Using word-analysis centered research, I studied the poems contained within Fascicle-22 and found that Dickinson's portrayal of military casualties within Fascicle 22, is overwhelmingly eloquent. While some critics argue that the way she intends to make the reader react to the deaths differ from poem to poem, Fascicle 22 treats all the deaths of a military member with the same tone. There are seven positive word associations with death within the twenty-two poems. More specifically, my research centered on the poem "He fumbles at your Soul". It would be beneficial to have all USAFA students read Dickinson's poetry from Fascicle 22, with particular attention paid to "He fumbles at your Soul" and "Whole Gulfs— of Red". Perhaps Dickinson's description of mortality can serve as an informal training, resounding even deeper the beauty of death and easing the process future officers will have to deal with. While my research is focused more towards the military and USAFA, the lessons learned are applicable to students, leaders, and professionals from across disciplines.





# Department of Foreign Languages and International Studies

A comparative analysis between Cantos de Vida y Esperanzas by Ruben Dario and Veinte poemas de amor y una canción by Pablo Neruda.

C3C Nathaniel Kolligs

Faculty Mentor: Dr. Ismenia Sales de Souza

## Abstract:

Many studies have been conducted on the well-known literary work of Ruben Dario; the father of Modernism and well known for his literary work. Certainly, the vast number of literary works on this literary work has contributed to the field of literature. However, it is lacking a comparative analyses between Ruben Dario and Pablo Neruda. Therefore, the purpose of this paper is to make a comparative analyses between Cantos de Vida y por Ruben Dario and Veinte poemas de amor y una canción de Pablo Neruda...



A Comparative Study between Specific Latin American military academies and US Air Force Academy

C2C Pamela Butanda and C1C Patricia Nieves

Faculty Mentor: Dr. Ismenia Sales de Souza

## Abstract:

The Latin American military academies to include Chile, Colombia, Brazil, Dominican Republic, Panama, and Peru are culturally different, and in turn construct and meet military objectives differently. The Spanish and Portuguese language and knowledge of their culture bolsters the understanding that Latin America is distinct in its nature of concentrating on inclusiveness, stamina, hard work, dedication, and grit. United States military leaders can only learn from Latin American counterparts operations through language and cultural immersion. This includes becoming familiar with military jargon, typical day-to-day activities and expectations, as well as the mindset required to flourish in their environment. A comparison between United States military operations and Latin American operations helps to distinguish the differences and similarities of military life, and in turn determines how these groups can best work together towards a common goal.

## **A Study of the Present Condition of Selected Indigenous Tribes in Latin America**

**C3C Thomas Kamp**

**Faculty Mentor: Dr. Ismenia Sales de Souza**

### **Abstract:**

Today in the Americas, if you look closely you will see the remnants of two continents of diverse and magnificent civilizations. The remnants of these civilizations remain in museums, archeology, and the descendants of these great tribes and empires. But these descendants of the original inhabitants of the Americas, while some preserve the beauty and glory of their ancestors' cultures, are but fragments of a bygone era. This essay will not attempt to explain the fall of these peoples, but rather the different situations that led to different native groups today to be in different conditions. What are left of these incredible civilizations?

**A survey of the scholarly works and their perspectives about the “Nuevo Mundo” the colonizers, and especially Hernán Cortés and his Cartas de Relación**

**C3C Vincent Coleman McDonough**

**Faculty Mentor: Dr. Ismenia Sales de Souza**

### **Abstract:**

The purpose of this paper is to do a survey of the scholarly works and their perspectives about the “Nuevo Mundo” and the colonizers, especially Hernán Cortés and his Cartas de Relación. There are controversies and disagreements among scholars in regard to the veracity of Cortés's narrations in regard to his letters to Carlos V of Spain.

## **A Study of Toxic Masculinity & Machismo in Selected Cultures in Latin America**

**C2C Benjamin Brooks**

**Faculty Mentor: Dr. Ismenia Sales de Souza**

### **Abstract:**

The purpose of this paper is to do an analyses of the origin and progression of the “machismo” (toxic masculinity) in selected cultures in Latin America. I will analyze this phenomenon from the colonial period to the XX century. Also, I will analyze how the machismo have led to objectification of women contributing to unequal and lack of fairness in society. In order to pursue this study, I will analyze the writer Sor Juana Ines de la Cruz and the literary work Hombres necios que acusáis. Finally, I research scholarly works and perspectives in regard to machismo in Latin America.



# Department of History

## A Horrified Silence: American Reaction to the Liberation of Nazi Concentration Camps C2C Teresa Kozak

### Abstract:

January 27, 2020, was the seventy fifth anniversary commemorating the liberation of Auschwitz, a Nazi concentration camp where over a million people were murdered as victims of a mass genocide. While Auschwitz was liberated by members of the Soviet Union army, the American military played a large role in liberating many other concentration camps including Buchenwald, Dachau, and Mauthausen. This paper will examine the reactions of several different groups of people to the liberation of the camps: American soldiers personally involved in the liberation, the American government, and the general American public. My hypothesis for these three reactions is that the American soldiers were filled with disgust and disbelief, the American government felt a lack of sole responsibility and was hesitant to disseminate the information, while the American people were filled with shock and outrage. On July 23, 1944, Majdanek was the first concentration camp to be liberated as Soviet soldiers captured the camp during the final stages of the war. Around fifteen of the twenty four major camps were liberated by Soviet, American, or British forces, the rest were liquidated prior to the allies' arrival. The liberation of major concentration camps ended on May 9, 1945 as Stutthof was the last camp to be liberated. My research questions will examine any differences in the information the American government had concerning the concentration camps as opposed to the general American public. I believe that the American public knew that the German government was sending certain "undesirable people" to work or internment camps, but it was not until after the liberation of the camps when the evidence of the gas chambers, crematoriums, and mass graves appeared that they began to realize the full extent of Nazi atrocities. Another research question that I hope to answer is discovering what motivated the American government to share certain pieces of intelligence with the American public and keep other information regarding the camps secret. Also examining why they chose the medium they did, newsreels, photos, newspaper articles, to make the public aware of the camps' existence. Potentially, it had to do with supporting the war effort by ensuring American troops were not sent on humanitarian missions rather than maintaining superiority in both the European and Pacific theater. While anti-Semitism and eugenics existed in America, public opinion could have demanded that America intervene to stop the genocide earlier, due to the severity of the Holocaust's crimes.

## **Base Aéro-Terrestre: An Analysis of French Strategy in Indochina**

**C2C Wyatt Lake**

### **Abstract:**

The French return to Indochina after World War II reinvigorated Viet Minh resolve to expel any foreign forces from the region. Fighting between the two forces broke out in September 1945, while is officially recognized as starting the French Indochina War in December 1946. Initially, the French found it difficult to fight the Viet Minh because Vo Nguyen Giap did not allow his forces to face the French in a conventional sense. To combat this, the French recognized the effectiveness of airborne operations. Paratroopers gave French commanders the ability to bring firepower to the Viet Minh before they could run. The effectiveness of paratroopers in combat and in seizing enemy territory created a heavy reliance on airborne operations. French commanders, like General Raoul Salan, found that airborne operations provided flexibility in both offensive and defensive operations. Salan studied General Orde Wingate's "hedgehogs," which were designed to entice an attack by looking undefended, while actually supplied by an air bridge. At the Battle of Na-San in November 1952, Salan put his Base Aéro-Terrestre, to the test. Giap attacked Na-San, but could not break through its defenses of superior firepower. Salan combined small arms, artillery, and airstrikes to successfully defend the base. General Henri Navarre replaced Salan in May 1953 and became obsessed with the success at Na-San and wanted to create his own "air-land" base. Navarre was over reliant on airborne operations, which provided Giap an opportunity to defeat the French. The French lost at the Battle of Dien Bien Phu because Giap learned from Na-San and rendered French aircraft and artillery useless. This paper explores the development of French strategy in Indochina and attempts to convince its readers that the French "air-land" base strategy during the First Indochina War was an effective tool only used ineffectively at Dien Bien Phu.

## **Changing Spaces: Comparisons of Kurdish Insurgency Techniques**

**C2C Veronica Cunningham**

### **Abstract:**

Turkey's "Kurdish problem" has existed since centralized government was implemented in what is today Turkey, Syria, and Iraq. The cultural and political tension stems from the lack of Kurdish government representation, the denial of sovereignty over ancestral homelands, and a strong tribal connection tying past conflicts to the current fight of the Kurdistan Workers' Party (PKK). The desire for a sovereign nation and the necessary military action to achieve that end has long been the basis of Kurdish rebellion and the PKK's war against the Turks. Mandates stemming from the Treaty of Sevres and the Treaty of Lausanne and continuing through the 1980s have



shown a consistent history of discrimination against Turkey's largest minority. Responses to the supposed attempts at colonization of the Kurdish people are manifested in rebellions, ambushes against Turkish-backed bandit groups, and skirmishes in the Taurus Mountains and along the border of Syria. Clashes at Sheikh Said, Mt. Ararat, and Dersim are reminiscent of intertribal warfare during the Ottoman Empire, with similar fighting styles and factors that originally spurred Kurdish armed conflict. By examining past conflicts between the Kurdish people and those they call "colonizers," through first-person perspectives from front line Turkish and Kurdish soldiers, this paper will demonstrate that Kurdish methodology and ideology of resistance remained stable over time, despite dynamic territorial changes in the Middle East portraying the "Kurdish problem" as unstable. History informs the Kurdish issue in light of the Syrian Civil War and international attempts to address the long standing desire for sovereignty. As the same techniques are used by the international community and enemies of the Kurdish state to solve the sovereignty debate as were used in the beginning of the "Kurdish problem," the primary methods of Kurdish rebellion remain steadfast and will remain so until the war against the Turks is resolved.

### **Chasing Antiquity**

**C2C Maria G Gasparovich**

#### **Abstract:**

Most would not recognize Imperial Russia as a powerhouse of Hellenistic antiquity. Reaching its peak at the height of the 18th century, European nations scrambled in what is now referred to as an art war for great antiquities coming out of Italy and Greece. At a time where Russia was seen as technologically and culturally inferior to their contemporaries, Russian rulers used antiquity and later the production of art as a way to elevate their presence globally despite their internal setbacks. This paper will analyze the relationship between Moscow royalty and Russian politics from leaders such as Peter the Great and Catherine the Great, in an attempt to show the curiously deceptive relationship Russian reagents had with art. It is hard to say whether or not Russian aristocracy understood the lasting effects the art war between European nations would have on the lives of antiquities they collected. The geographical location of Russia compared to the origin of its Hellenistic and later artworks provides a lure of mystery and awe to visitors of the crown's first gallery, The Hermitage. The colossal amount of funding from the crown to bring in great works and establish education in the arts seems jarring to some when compared to the meager and poor lives of the majority of Russia at this time. At the same token, the artworks created out of the academy in St. Petersburg up until the end of the aristocracy of Russia never reflected the lives of the majority, which exemplifies the real attitudes of the crown during this period of Russian history. If art was to serve any purpose, it was to serve the crown and represent Russia as a global superpower. While the stereotype of Russian culture is bleak and uninviting, this narrative will explain the presence of works from da Vinci in the Winter Palace and how it shaped foreign diplomacy under Imperial Russian rule.

## Operation Eagle Claw and the JSOC

### C3C Haley Jones

#### Abstract:

Operation Eagle Claw and the Iranian Hostage Crisis left the United States' (US) armed forces with the infamous saying "the guts to try." It marked the first joint force operation in United States' military history, including all three branches of the armed forces. A rescue mission of this caliber would take all services to give the United States its best possible outcome. Instead of completing the mission and rescuing the 66 American hostages in Tehran, eight service members died while refueling 300 miles out of the city. Eagle Claw proved fatal, but the lives lost were not in vain. Because of its disastrous execution, United States' military made drastic changes to its structure that paved the way for the dedicated United States Special Operations Command. The Goldwater-Nichols Act and the Joint Doctrine Publications, direct products of the mission failure, set up this new combatant command. Along with a new command came the assurance of Operations Security (OPSEC), establishing more clear Command and Control, and creating equipment reliable to each mission. Decades before Operation Eagle Claw and the changes that came with it were the rising tensions between the United States and Iran. The roots of Eagle Claw date back to the 1950s, when the United States conducted a military coup against the Iranian government. This overthrow was known as Operation Ajax, the CIA's plan to overthrow Muhammed Mossadeq's government and reinstall the Shah to the throne of Iran. The resounding success of Operation Ajax and America's secrecy in its direct involvement stayed until 1979, when America offered aid to the Shah so that he could receive cancer treatment in New York City. The leader of an Islamic republican faction, the Grand Ayatollah Ruhollah Khomeini, established his power in office once the Shah left for America. His first major act as ruler was to capture the American Embassy in Tehran, Iran, and hold them captive. Once captured, the Carter Administration approved Operation Eagle Claw, their attempt at a joint-force operation to rescue the hostages kept in Tehran, Iran. Before they could fly into the American Embassy, the troops must stop 265 miles out of Tehran at what was known as "Desert-1," or their refueling stage by three C-130s. However, the troops never made it past Desert-1, where three of their eight RH-53Ds were deemed inoperable. After the crash at Desert-1, the five-month planning stage of Operation Eagle Claw and its disastrous execution is credited with three major reasons for its failure: Operations Security (OPSEC), Command and Control, and equipment reliability. Enhanced joint operation capabilities were brought to light with this failure. Significant military reforms, such as the Goldwater-Nichols Act and the Joint Doctrine address the readiness and capability issues demonstrated in Operation Eagle Claw. Exploring this culture shift after Operation Eagle Claw explains the significance of this mission and ultimately how the lives lost during this operation were not in vain. The lessons learned made special operations into what we know them as today.



## Filipino Indigenous Identity and Integration into a Decolonized and Globalized State

C1C Natasha Weimer

### Abstract:

Through this research project I seek to explore the ways in which the Ifugao people are tasked with integrating into the post-colonial Philippine state and the challenges posed with preserving Ifugao identity while adapting to mainstream Filipino identity. The Filipino Igorot, a collective term used to describe the various ethnic minorities in the Cordillera mountain ranges in the northern Philippines, largely escaped forced integration into the Spanish empire thanks to their geographic location. Because Igorot largely escaped three hundred years of Spanish colonization, they preserved many pre-Hispanic traditions, holidays, religious practices, socio-economic structures, and headhunting practices. In attempt to narrow the scope of identity preservation and changes, I will be focusing on the Ifugao, an indigenous ethnic group that practiced head hunting well into the 20th century who's 2,000 year old socio-ecological system (SES) centered on rice terracing exists to this day. The indigenous people of Cordillera received governmental "autonomy" in 1987; however, preservation of ancient practices and tradition efforts struggle to stay afloat with increased access to tribes and villages by the Philippine government for tourism purposes. This research coincides with my current History Capstone project of tensions resulting from Indigenous integration into the Philippine state post decolonization; however for the purposes of CSURF I wish to take it a step further and discuss the current issues faced with indigenous erasure and efforts of preservation in Cordillera. Although the scope of this research project is narrowly pointed at an obscure cluster of indigenous groups in the northern Philippines, I believe it is relevant to contemporary issues of integration of indigenous peoples into a globalized and modernizing world. I would briefly discuss the Ifugao and their region during the four-hundred years of imperialism and occupation. I would then examine how the economic factors of the modern day Philippines drew indigenous groups from self-sufficient socio-ecological systems into a position of dependency on the world-system according to Wallerstein's World-Systems Theory. Modern economic demands of the post-American colonization era intermingled with deep-rooted ethnic tension from racialized differences of colonial rule have changed the fundamental lifestyle of the Ifugao people deep within what was once a remote and isolated rice-terraced mountain range. Philippine state efforts to increase accessibility to these once sheltered societies have brought unsurmountable challenges to family structures, land management, the indigenous religion. Economic opportunities outside of villages and the country led to creation of indigenous diaspora groups throughout the Philippines and the world.



## France and the Creation of a Vietnamese National Air Force, 1950-1954

C2C Mark Schell

### Abstract:

In 1946, after months of tense but fruitless negotiations, France and the communist Viet Minh went to war over control of Vietnam. Initially France seemed certain to win the conflict, with a larger and better equipped military than that of the communists. However, in a stunning reversal, the struggling colonial power found itself on the defensive by 1950. In an attempt to salvage the situation, the French turned to the native Vietnamese population for recruitment into the indigenous armed forces, specifically the French-led Vietnamese National Army (VNA). However, it is little-known that the French also attempted to establish a Vietnamese National Air Force. By late 1950, the French recruited some of the most intelligent and promising officers in the VNA to attend pilot training. Their efforts, though, were largely in vain. Faced with meager resources and apathetic leadership, the Vietnamese trainees were never effectively used in combat. The French, who assumed responsibility for training, equipping, and implementing an independent Vietnamese National Air Force, singularly failed to achieve an effective fighting unit by the cessation of hostilities in 1954. By analyzing the personal accounts of a pilot trained by the French during this period and primary source documents from the Foreign Relations of the United States series, as well as secondary sources like *Assuming the Burden* by Mark Atwood Lawrence, I will support the thesis that the French failed to create an independent Vietnamese National Air Force because they suffered from conflicting political objectives, lacked the necessary logistical support, and ultimately mismanaged the training and implementation of the Vietnamese pilots. It is a failure that no modern military seeks to repeat.





## He Said Xi Said

C1C Myles Arenson

### Abstract:

The People's Republic of China (PRC) is a rising revisionist power whose actions pose a significant challenge to the United States and its allies. To face this challenge, US national policy under Pres. Donald Trump focuses on competing with PRC aggression. National policy like the National Security Strategy (NSS) and the National Defense Strategy (NDS) have outlined deterrence as the cornerstone for military strategy with the PRC. In its Indo-Pacific section, the NSS states that the United States "will maintain a forward military presence capable of deterring and, if necessary, defeating any adversary." The NDS outlines the need for the United States to "deter adversaries from aggression against our vital interests." More specifically, the NDS highlights the need to "set the military relationship between our two countries [US and PRC] on a path of transparency and non-aggression." Effective communication is required for transparency, as well as any strategic deterrence operation. Any breakdown in signaling degrades a nation's ability to effectively deter enemy aggression, making that nation more exposed to enemy threats. Communication or signaling is a necessity in all strategic deterrence operations. The United States and the PRC have an extensive history of failing to effectively communicate or signal one another. The implications of communications breakdown between the United States and the PRC could lead to misunderstanding and unintended escalation between nuclear powers. This would certainly devastate both nations, in addition to the global community. Given the history of communication failures between the United States and China, the United States needs to develop a more effective communications strategy to effectively deter China and meet the objectives of the NSS and the NDS.

## I Am with You to the End

C1C Lawrence King

### Abstract:

In September 1942, LTG Dwight D. Eisenhower, the Commanding General of US Forces, received notice of a leaked cable. Charles de Gaulle, leader of the Free French Forces, sent the cable to his subordinate officers. It scoffed at so-called American military support for their cause, furthermore accusing the US of purposely delaying communications and espousing an "attitude of stand-offishness towards the Free French." Almost eighteen years later, the dynamic between Eisenhower and de Gaulle looked very different. Following a tense and unproductive roundtable at the Paris Summit in May 1960, de Gaulle privately conveyed to Eisenhower and his aide that "Whatever he [Khrushchev] does, I want you to know that I am with you to the end." From 1942 to 1960, Eisenhower and de Gaulle transcended their initial bitter contest of wills to create a genuine alliance. This presentation will examine the unlikely rapport between these two

military and political giants, which was founded in the cauldron of World War II. It will consider how this unique relationship reached its apex during the Cold War, acting as a cornerstone for Franco-American relations from 1958 to 1960, one of the struggle's darkest periods.

### **Nixon, the Joint Chiefs of Staff, and the Vietnam War, 1968-1973**

**C2C Cadet Mark Schell**

#### **Abstract:**

The Nixon administration assumed the helm of U.S. foreign policy at a crucial period in the Vietnam War. After the egregious mismanagement of the Johnson administration, Nixon sought to avoid further degradation of U.S. prestige and chart a politically feasible way to extract America from the conflict. Nixon also wanted to avoid the mistakes of his predecessor - who largely sidelined professional military advisors - by including the Joint Chiefs of Staff (JCS) in policy planning and decision making. Despite his desire to incorporate the JCS, the president quickly grew frustrated and disappointed with the performance of his principle military advisors, who tended to resist change and lack initiative. In response, he largely turned to Henry Kissinger, his National Security Advisor, Alexander Haig, Kissinger's military advisor, and Creighton Abrams, the commander of the Military Assistance Command, Vietnam (MACV), to assist strategic planning in Vietnam. President Nixon simultaneously limited the influence of dissidents within the administration - including the JCS - through a variety of deft political maneuvering, misinformation, and isolation. It can be shown that by the time hostilities ceased between the United States and the North Vietnamese in 1973, Nixon largely eliminated the JCS from the decision-making process. This thesis is supported by persuasive documents from the Foreign Relations of the United States series, Henry Kissinger's White House Years, Jeffrey Kimball's Nixon's Vietnam War, and many other primary and secondary sources.

### **Power Politics and Turkish Identity**

**C2C Kathryn Power**

#### **Abstract:**

The rise and fall of various government administrations are accompanied by a significant shift in the identity of its subject peoples. The most effective rulers are usually those who manipulate this process to create an identity for their peoples that aligns with their own political goals. By comparing and contrasting the Ottoman Empire under Mehmed II and the Turkish Republic under Mustafa Kemal Ataturk, it is clear that each leader had an agenda of recrafting a new identity for their people in an effort to consolidate power in the midst of a changing society. Both leaders used a technique of supplanting an identity associated with previous powers with identities that were not new, but had been dormant for some time. For Mehmed II, this meant reinforcing Islam as a unifying force across ethnicities living in the Ottoman Empire. Ataturk chose to re-emphasize



ethnic Turkish nationalism to supplant the Ottoman power that had controlled Anatolia for over six centuries. While differing in technique and which identity they chose to highlight, each leader enabled a disenfranchised people to rise to positions of contemporary regional power, yielding similar outcomes. These shifts in ethnic, religious, and social power are evidenced through the capital cities that Mehmed and Ataturk created for their new regimes. Specifically, art and architecture associated with their cities mark deep transformation in Anatolian society as a result of state sponsored efforts. Sources providing support for Mehmed's crafting of a uniquely Ottoman identity include Qur'anic hadith, quotes, and scholarly analyses translated to English. Those demonstrating Ataturk's emphasis on modernization, Westernization, and a return to pre-Islamic influences include mandates regarding domestic policy and key elements of new capital Ankara's design.

## **Women of the Third Reich**

### **C3C Ellie Beaulieu**

#### **Abstract:**

The narrative of The Third Reich has always followed two narratives. The first, the voice of the perpetrators, the Nazis, and the second, the resisters. While these two narratives are important to understanding Germany's history, the third narrative, of the bystanders, is just as important in recognizing how history impacts the world today. This category of citizens is composed of mostly women, and for the purpose of this research, women will be focal point. Women in Germany during the Third Reich found ways to both justify and resist the actions of the National Socialist party. Using primary resources during this time period this research will aim to dive into the different reasons German women at the time internally justified the changes around them. The largest change women felt directly was their loss of political and social rights. Females were now confined to the house and their main purpose was repopulating and raising the next great generation of Germans. While the Third Reich is a vastly studied section of German History, applying the lens of gender will provide a new perspective. Prior research on this topic has covered deep research into the sphere of women in the Third Reich, but not how these women supported and justified national goals. This research will aim to find the ways women reacted to these vast changes in their sphere of influence. By breaking women into categories of those who supported the national goals, those who were reluctant, but eventually pressured into their roles, and those who resisted, this study will take into account many primary sources and the stories behind women's lives. The working thesis to this project is: Women had two reactions to their loss of rights. The first reaction was support, which was caused by indoctrination and propaganda techniques the Nazi party used to recruit female supporters. Resistance, the second reaction, was due to the restrictions placed on women economically and the forced ideas of National Socialism.

## **Xinjiang, Vietnam, and China: Case Studies in the CCP's Response to Cold War Geopolitics**

**C2C Jackson Ayers**

### **Abstract:**

In recent years, China's policies towards its ethnic minorities (少数民族) and their corresponding national representatives have grown apart, characterized by oppression at one end and aid on the other. During the Cold War however, the CCP's attitudes towards ethnic minorities fluctuated in line with the course of the war between the US and USSR. As Soviet and American power grew internationally, China sought influence in multiple regions such as their Uighur dominant Xinjiang province or non-aligned Middle Eastern and Southeast Asian countries. China enticed these nations when power was needed and abandoned them when power could be gained elsewhere. The direct influence of the Cold War's bipolar hegemony on China's frontier forced the CCP to adapt policies towards traditionally marginalized or even unincorporated ethnic minorities. Through Chinese newspapers such as the People's Daily (人民日报), conversations between Mao and his partner nations' leadership, and CIA reports of China's domestic activities, a picture can be painted of China's intentions for its ethnic minorities. Unlike recent investigation into predominantly negative Sino-Minority relations, this paper argues that those interactions went through periods of both positive and negative change directly mimicking China's relationship with the Cold War.

## **Influence of Female Spies during the American Civil War**

**C2C Beth Gordon**

### **Abstract:**

The topic of this paper is the influence of female spies during the American Civil War. It focuses mainly on young women such as Rose O'Neal Greenhow, Belle Boyd, and Elizabeth Van Lew who were able to complete the substantial feat of successfully infiltrating enemy intelligence and relaying it to their commanders while maintaining trust. While often overlooked and romanticized, these women's contributions made substantial effects on the course of the war. These three women are examined in depth and their contributions are explained using multiple primary sources. Rose O'Neal Greenhow's views on Southern identity and loyalty were largely shaped by Calhoun and his influence. Throughout the war Greenhow stayed in the Union capital of Washington D.C. and ciphered secret messages to the Confederate high command depicting Union military strategies. One of the most notable contributions to the Confederate cause Greenhow made was the battle of Bull Run. Her intelligence on the mobilization of troops from Washington allowed the Confederate army to prepare themselves, thus allowing for a Confederate victory and influencing the course of the entire war. Another Confederate female



who used her connections and charm to infiltrate Union intelligence was Belle Boyd. While Boyd is one of the most famous female Civil War spies, the cumulative effects of her actions are sometimes neglected. Boyd utilized her womanly charm to infiltrate Union camps, gain the trust of men, be couriers for them, and then relay that information to the Confederates. It wasn't just the Confederacy that utilized female spies, Elizabeth Van Lew was a Unionist from Richmond who began her espionage career in an innocent way, by visiting and bringing supplies for Union prisoners detained at Libby Prison in Richmond. Slowly Van Lew's actions of aid for the Union increased over time. In 1863 she began helping Union soldiers escape from prison through her network of Union sympathizers in Richmond. Even more notably, Van Lew gathered information from inside the besieged city of Petersburg which greatly affected Richmond and transmitted it in coded dispatches. Through this research it is clear that the actions of female intelligence operatives in the Civil War such as Rose O'Neal Greenhow, Belle Boyd, and Elizabeth Van Lew made tangible effects on key events in the war which in turn affect the momentum of each respective side. Without these contributions, it is difficult to imagine the course of events during the Civil War. While often romanticized, women's part in the war was not minimal and cannot be forgotten.

### **East Timor: A Study in Human Rights Abuses and Geopolitical Implications Abstract** **C3C Lily Selvaggi**

#### **Abstract:**

In Plato's *The Republic*, Socrates debates the nature of justice in mankind. Is the government merely a reflection of the strong and those wills imposed on the weak? Does humanity obey the law out of fear of the repercussions or do humans behave justly because it is good in it of itself? For the island of East Timor, the nature of justice can be seen through the actions and inactions of three intertwined agents: faithful grassroots movements, encroaching Indonesia, and impassive global powers. Known locally as Timor-Leste (Leste means 'east' in Portuguese), East Timor only gained full independence in 2002 after four centuries of colonial rule. This liberation could not have been achieved without international media relevance and pressure upon foreign admiration. However, it was a lack of international interest during Timor's first opportunity for independence that resulted in the additional, twenty-four year Indonesian regime and over 200,000 deaths of the East Timorese—approximately one-third of the population. This paper will examine the Indonesian invasion and occupation of East Timor from 1974 to 1999 unveils the global relationship, unveiling an asymmetrical power dynamic between the East and the West. Drawing from newspaper articles, memoirs, and government documents, it will consider the context surrounding the invasion and how Indonesia used circumstances to its advantage. In addition, it will examine the roles of Western powers, highlighting their selective concern for the East Timorese while also contributing to President Suharto's regime. It argues that Indonesia saw an independent East Timor as a threat to Suharto's totalitarian New Order and utilized



Operation Komodo to destabilize the region. This way, military action on East Timor would not be seen as the self-interested actions of a predatory country, but the altruistic intervention of a principled nation before civil war. In return, global powers prioritized regional stability and anti-communist actions over severe abuses in human rights. This study of East Timor implies a global network of responsibility and an obligation to critically consider the effects of self-interested strategic agendas. It asks the larger question of where do geopolitical objectives end and where considerations of fundamental human rights begin?

## **The U.S. Air Force Academy “Air Warrior Combat Memorial” Recognizing the Contributions of Air Warriors in History**

**C1C Daniel Smith**

### **Abstract:**

From the Wright Flyer to modern Remotely Piloted Aircraft, the evolution of aircraft and airpower delivery systems is incredible. As these technologies developed, innovative airmen rose to meet the challenges they introduced. The definition of what it means to be an airman and a warrior has evolved dramatically over the past approximately 100 years of flight. Through the USAFA Endowment and the Association of Graduates, the U.S. Air Force Academy Class of 1971 is developing the Air Warrior Combat Memorial. The project began in 2011, rooted in the desire to honor all airmen - including many of their classmates who contributed to the war in Vietnam and Southeast Asia - for their contributions as warriors. The Class of 1971 contacted the USAFA Center for Character and Leadership Development, as well as the USAFA Department of History, in order to create chronological display panels to detail the history of air combat and the American airmen who fought. Under the direction of Colonel John Abbatiello (USAF, retired), three USAFA cadets began an independent study of air combat warriors in order to produce thirteen narrative display panels for the memorial. The cadets utilized the USAFA McDermott Library, Air University publications, and independent research to determine the most important air campaigns, as the audience of the memorial will likely be a mix of military and civilian patrons who visit the Air Force Academy. The display panels may be the first introduction of these air campaigns to many who visit the memorial, scheduled to open in 2021. Cadet Daniel Smith is one of the three cadets from the Department of History who contributed narratives for the project. His submissions included “Persian Gulf War,” “War in the Balkans,” “Global





War on Terrorism: Afghanistan and Iraq,” and “Global War on Terrorism: RPAs and the Remote Combat Warrior.” His final submission is aimed to reshape the conventional thinking of what defines a warrior, which is an important objective in light of the establishment of the United States Space Force and the growing role of cyber in modern warfare.

## **Operation Halyard**

**C1C George Crist, C1C Abby deVarennnes, and C1C Romel Spight**

### **Abstract:**

Operation Halyard successfully rescued the most downed airmen in American history, so why does nobody know about it? The airlift was conducted in Serbia during the Fall of 1944, where the American Office of Strategic Services organized Allied airpower and Chetnik resistance forces to locate and exfiltrate airmen. Throughout the process, the American government had to wrestle with the British government who did not trust the Chetniks and gave their allegiance to the communist partisans in Yugoslavia. While tackling complex political issues throughout the operation, the Americans crafted an audacious plan to rescue the downed American airmen. The Chetniks rebels, led by Draza Mikailovich, found airmen after their planes were shot down by the Nazis and led them to the extraction town of Pranjani. Our trip to Serbia immersed us into the history of Operation Halyard while at the same time studying the unique perspectives of the British, Chetniks, and Americans. The purpose of this panel is to bring exposure to this operation while providing analysis of Air Force personnel recovery operations and other special operations. The panel will employ a bottom-up approach, focusing on independent actors and individual stories. This perspective was fostered during an immersive celebration of the 75th anniversary of the mission in September 2019. Operation Halyard presents an early model for how the United States conducts joint and combined special operations today. The operation set the precedent for the immense value the United States Air Force places on personnel recovery missions. The rescue operation is significant not only in its scale but the nature that it employed similar facets of airpower to modern special operations. The operation involved the utilization of take-off and landing from an austere environment while establishing security through the Chetniks. In addition, the local population heavily aided the Americans by providing shelter and protection until allied forces arrived. Despite the adoption of less advanced tactics, techniques, and procedures of contemporary personnel recovery operations, Halyard was able to create the same successful effects. Through a three-person panel, each person will expand on how the British, Chetniks, and Americans participated in the airlift of over 500 Americans in order to spread this remarkable story.

**Abstract:**

Between 1932 and 1933, an estimated 4 million Ukrainians died as a direct result of Josef Stalin's genocidal policies. Due to Ukraine's broad refusal to collectivize, Stalin employed the OGPU, the Soviet secret police, to slaughter 30,000 middle-class farmers. Thus began a severe agricultural downturn in Ukraine, the Soviet Union's breadbasket. Stalin continued to requisition grain and confine Ukrainians within the zones of this man-made famine without any means of survival. The crisis reached its peak in June 1933, when 28,000 people died each day due to starvation. Stalin ultimately confiscated more than 40% of the Ukraine's grain supply, prevented any escape, and intentionally killed the Ukrainian population. This paper argues that the Ukrainian Famine, also known as the Holodomor, was a genocide of Stalin's making that deliberately targeted Ukrainians as a national group through his genocidal policies. Despite recent attempts to understand the complexities of this atrocity, the Holodomor largely remains unexamined and therefore labeling it a genocide is both controversial and divisive. With an approach that embraces both history and political science, this paper examines the Holodomor and Stalin's intent, arguing that it was, indeed, a genocide. Journal excerpts, letters, and memoirs reveal first-hand accounts of the events of the Holodomor, providing significant evidence on how victims experienced the famine and how survivors remember it. First arguing that the Holodomor was a genocide in a legal context, this paper explores collective memory of the event and how memorialization, or the lack thereof, further defines the famine as a genocide in the hearts of the people.



# Department of Law

## Impact of the Electoral College

C2C Mariah Grant

Faculty Mentor: Maj Chase Gunnell

### Abstract:

In this paper and presentation, I explore the impact of the Electoral College on the democratic government of the United States. I demonstrate that the Electoral College acts as a counter to the “majority rule” which is so crucial to our democratic form of government. This paper first discusses the Framers’ original intent when establishing Article II Section 1 of the Constitution. It then explores what the Electoral College does and how it has been used in past elections. I contend that Congress should pass an amendment that abolishes this board of electors, in order to protect our nation’s democratic values. Although The Electoral College was established with a claim of “rule by the people,” it actually acts as a cloak to shield the American citizen’s eyes of its true purpose: rule by the few. In addition, I use the Supreme Court’s and the district courts’ decisions in *Colorado Department of State v. Baca*, *Chiafalo v. Washington*, and *Ray v. Blair* to prove that the idea of “faithless electors” exist, and it has a dangerous impact on not only U.S. citizens, but also on our highly valued idea of democracy. Furthermore, I use examples such as the election between President Trump and Hillary Clinton to further prove my point that the Electoral College overrides our values as a democracy. In Trump’s election and in four other elections, the Presidential candidate with the popular vote lost the elections due to the Electoral College. Finally, I argue that abolishing the Electoral College will allow for a truly democratic system of government, and I address counterarguments to my proposal.

## The Impeachment Process in the United States

C2C Sarah Masinter

### Abstract:

This article suggests that the impeachment process in the United States has failed to hold the office of the President accountable. The way that impeachment was outlined in the Constitution was not defined well enough to provide a consistent, thorough, and unbiased procedure to prevent abuses by the President. Historically, in the four of the previous instances when the President underwent impeachment procedures, partisan politics have prevented an unbiased examination of the facts. First, this paper will outline the history of impeachment throughout the world, and then focusing in on the United States. Second, this paper will argue that the impeachment process needs to be updated through an additional amendment to the Constitution.

This amendment would define and describing the proceedings that would occur in the House of Representatives during the impeachment process, as well as the way that the Senate would carry out a trial. It would also introduce an addition to the process. Rather than the Senators voting on whether to remove the President from office, a popular vote would occur, with the same proceedings as a Presidential election. This would allow the final decision to come from the voice of the people and help eliminate some of the blatant partisanship that has so clearly overtaken the impeachment process.

## **Responsibility to Protect: Syria and Somalia**

**C2C Brendan Richichi**

### **Abstract:**

The foundational question to this essay asks to what extent the United States' military and political environment makes intervening in humanitarian crises, specifically the Syrian Civil War, difficult and complex. The concept of Responsibility to Protect (R2P) is dwindling amongst the international community and is weak from a legal perspective since it is not legally binding, which overshadows any moral obligation that a State may have to intervene. In short, Responsibility to Protect is a failure by a state to protect its citizens from a genocide. The international community bears the responsibility of protecting that population under Chapter VII of the UN Charter, yet this is not legally binding. There are three major political science criticisms of humanitarian intervention: the liberal-internationalist theory, state-sovereigntist theory and realist theory that illustrate why intervention may or may not be optimal. The United States needs to restart the initiative in intervening in humanitarian crises and mass atrocities focusing on shifting R2P from a moral obligation to a legal obligation at the sacrifice of sovereignty. Taking into consideration the events that occurred in Somalia, as well as modern political and legal theory, the United States must lead a U.S. led intervention. This intervention must not be led by coalition forces, as this will likely generate confusion, mixed motives, and most certainly complicates objectives. While the legal importance of R2P is dwindling, the moral importance is paramount and embodies the ideals of the UN Charter and the international community's desire for peace and security.



## **Nationwide Immigration Injunctions: A Discussion**

**C2C Calista Torbenson**

### **Abstract:**

There have been many new immigration policies proposed and implemented throughout the Trump administration. Furthermore, there has been a 150% increase in nationwide injunctions from the eight-year Obama administration to the three-year Trump administration. Many of these binding nationwide injunctions are centered on immigration and border security. In January of 2020, the Supreme Court, in a 5-4 decision, lifted the final remaining nationwide injunction on the public charge rule. This rule sets a new standard for determining whether an immigrant could be a public charge to society. The public charge rule was set to take effect on October 15, 2019; however, multiple federal courts issued nationwide injunctions stopping the rule from taking effect. The Supreme Court in *Chae Chan Ping v. United States* (1889) made the determination that issues on immigration are “not questions for judicial determination.” The Supreme Court granted plenary power to the legislative and executive branches of government to control immigration. However, since 1889, the Court has broadened its scope of powers in relation to immigration through a series of cases and, more recently, nationwide injunctions. The increased and widespread use of nationwide injunctions issued by unelected district judges have impeded the powers of Congress and the Executive. The recent influx of power through the tool of nationwide injunctions threatens the idea of equal branches of government. Uneven power distribution could have enduring effects on immigration and its policy. Therefore, it is important to identify how the United States can prevent negative effects of nationwide injunctions to create a better future for citizens and immigrants.

## **Hostile Intent in Outer Space**

**C2C Aryemis Brown, C3C Drew Espinoza, and C4C Tristen Paller**

### **Abstract:**

On March 23, 2018, United States President Donald J. Trump declared outer space a warfighting domain. A congested and competitive security environment challenges the “commons of space” with dynamic questions about international cooperation and conflict. The roaming space object has become a symbol and tool of national prowess and space superiority. The competing interest of various state and non-state space actors highlights the sensitive complexities associated with rendezvous and proximity operations and electronic warfare. These parties concurrently aim to preserve the sanctity of space and ensure a competitive advantage in the space national security and commercial industries, such as GPS, communications, and ISR. Hence, state and military leaders have recently considered the delineation between hostile and benign space activities. As such, in the twenty-first century, it is important to extrapolate enduring legal,

strategic, and political ideas to meet technical novelties. This research work is designed to approach the following inquiry: What constitutes hostile intent with regard to rendezvous and proximity operations (RPO) and electronic warfare (EW) in outer space? To answer this question, this research uses maritime and cyber analogs to relate existing international law structures and their practical implications to the outer space domain. This paper opens with an archetypical review of common RPO and EW space activities; then, it explores existing legal and political regimes in the outer space, cyberspace, and maritime domain to respond to these activities; finally, this paper proposes a derivative framework to distinguish hostile and benign behavior, as well as demonstrates its application to a hypothetical, prototypical RPO and EW space activity. The aim of this research paper is to appreciate the commons of space as a treasure for research and exploration, while accounting for a normative trend toward a militarized warfighting domain.

### **Presidential Policy Guidance**

**C3C Andrew Espinoza**

#### **Abstract:**

In 2013, President Barrack Obama approved the Presidential Policy Guidance on Procedures for Approving Direct Action Against Terrorist Targets Located Outside the United States and Areas of Active Hostilities (PPG). Domestic law was one of the significant considerations for President Obama when drafting the PPG. These procedures are heavily debated, with claims that the PPG hinders effective targeting operations due to increased legal standards and bureaucratic measures (Hartig). However, there are also arguments that the PPG is admirable due to its emphasis on exercising due diligence, minimizing civilian casualties, and increasing public transparency. President Donald Trump has taken a dissimilar approach to the PPG, as shown through his rhetoric, related policies, and actions as Commander-in-Chief (Chesney; Jurecic). President Trump decentralized command and control and lowered the threshold set by President Obama for direct action against terrorist targets within the aforementioned circumstances. President Trump's divergence from President Obama's policy has stimulated debates regarding whether his strategy is beneficial due to increased operational efficiency or detrimental due to decreased oversight and humanitarian considerations. These debates pose the following inquiry that this research work undertakes: which of the two strategies is better suited for current United States armed conflicts with regard to domestic law? To thoroughly answer this question, this research compares and contrasts the advantages and disadvantages of the two distinct approaches to direct action against terrorists outside the United States and areas of active hostilities under domestic law. The aim of this work is to demonstrate that while both President Obama and President Trump's strategies are effective in multiple respects, a synthesized approach, with elements from both strategies, puts the United States in the best position to accomplish its national security goals.



## **Immigration Policy**

**C2C Shirley Hao**

### **Abstract:**

The importance of our nation's immigration policy spans beyond just looking at our history and trying to learn from our mistakes. Currently, for our President to claim national security to block immigration from certain countries, there is no check or balance. We should push out ideals that will work. In the 14th Amendment of the Constitution, it is mentioned how all those born or naturalized in the United States are citizens of the United States, and no state shall enforce any law which hurts a citizens privileges, however, that is all the Constitution mentions about immigration. With no other instruction, immigration and citizenship has been left unambiguous for people. It wasn't until *Chy Lung v. Freeman* in 1876 when the power to set rules surrounding immigration was left solely for the Federal Government. By reflecting on past trends of immigration, including the Chinese Exclusion Act of 1882, the Immigration Act of 1924, the Immigration Act of 1965, and the current trends of immigration bans set forth by President Trump, there needs to be a check and balance system to ensure future Presidents create immigration bans based on national security rather than discriminatory reasons. The implications of this decision, would be a more selective process for immigration and a smaller allotted lottery option. This would open up immigration to much more people seeking asylum, however, would potentially close off immigration for those who would have otherwise got into the States through merit. The skill level of those immigrating would be polarized by those who gained immigration by great merit, and those who are seeking a safe haven.

## **The Motivators and Morality of Espionage**

**C3C Paul S. Khang**

### **Abstract:**

The term “moral spies” is contradicting. Spies are expected to break the laws of foreign countries by manipulating their citizens through lies, coercion, and other espionage techniques that question ethical standards, yet they are required to meticulously comply by their own nation’s laws and moral principles. Consolidating the moral limits of espionage creates difficulties as what constitutes an acceptable moral behavior varies upon the individual. However, time after time, numerous studies indicate that spies are driven by common motivators when conducting espionage. This presentation first examines the motivators for spies to conduct espionage through a multi-tiered framework using the acronyms MICE and RASCLS. MICE, which stands for money, ideology, coercion or compromise, and ego or excitement, is an organizational framework that was commonly used by the Soviet Union’s Komitet Gosudarstvennoy Bezopasnosti

(KGB) to identify the major motivators when recruiting their agents. RASCLS, which stands for reciprocation, authority, scarcity, commitment or consistency, liking, and social proof, is a framework developed by a psychologist, Dr. Robert Cialdini, which provides an additional assessment of the common motivators for espionage because human motivations are much more complex to be confined to the limits of MICE. This presentation will ultimately assess the morality of espionage through ethical frameworks, which include, but are not limited to, utilitarianism, subjectivism, and egoism. By examining this intriguing topic of espionage and its morality, I aim to clarify not only what motivates spies to engage in behaviors that, at times, question ethical standards, but whether spying is actually unethical. My sources of research to support my findings will be obtained from various intelligence publications by the Central Intelligence Agency (CIA), various primary sources written by former spies and their handlers, and the International Journal of Intelligence Ethics, which is a compilation of journals produced by numerous intelligence professionals.

**Duncan v. Becerra**  
**C2C Harper Lee**

**Abstract:**

Duncan v. Becerra, a court case decided by the Southern District Court of California, ruled that the recent Californian laws restricting the magazine capacity of firearms was unconstitutional. My paper and presentation argues that this decision was backed by the original intent of the Second Amendment of the U.S. Constitution and by recent Supreme Court decisions, and that the courts ought to take an individual right approach to Second Amendment issues. I approached the issue chronologically, first looking at the text of the Second Amendment and the intention of the founding fathers when they wrote it. I then addressed the two different approaches the court has taken: a collective right and an individual right. In *Miller*, the court ruled that the Second Amendment applied to militias and was a collective right of militias. However, the militias are supposed to be comprised of the armed population, which led to the second approach, that the Second Amendment right to bear arms is an individual right. This viewpoint is affirmed in *Heller*, as well as *McDonald*, in which the Supreme Court of the U.S. argued that the right to bear arms is a right beholden to the individual and not a collective group. This is essentially the analysis used in *Duncan*, however *Duncan* expands the right to bear arms to also include essential components to use arms, in this case the magazine of a firearm. This case should be affirmed based on its analysis and previous SCOTUS decisions, and similar laws should be addressed utilizing this analysis, an individual right approach, and a strict level of scrutiny for addressing issues that directly impede upon the core principles of Second Amendment rights, such as the right to defend one's self.



## Scope of Presidential Powers to Recognize States

C2C Gabrielle Topacio

### Abstract:

The crux behind the diplomatic recognition of states has become more relevant due to the growth of the international community and the inherent political impression of such action. In *Zivotofsky v. Kerry*, the State Department did not recognize Zivotofsky's birthplace as Jerusalem in an attempt to avoid upsetting Arab allies. Nonetheless, the Court found that the state was in violation of Article II of the Constitution and ruled that it rendered the authority to recognize a state exclusively to the President. This essay explores the scope of the president's recognition power and its trespassing of its constitutional powers afforded by Article II. First, I will briefly explain international law in recognizing a state and the United States' process of recognizing a state and its effects. Then I will outline the Framers' intent behind Article II and the dialogue about this topic from the ratification conventions. Then I will delineate the definition of ambassadors and public ministers and how receiving them does not equate to state recognition. I will then explore case precedent and the effects of these decisions in developing United States domestic policy and its role in international law. In declaring that the President has the exclusive power to recognize states, the *Zivotofsky* Court increased the executive power from merely conducting foreign relations to expanding his discretionary authority. Because his discretion ultimately portrays the nation's political standing in regards to foreign relations, the process of recognizing a state should be shared between Congress and the President to more accurately reflect the nation's political aspirations regarding international affairs.



**Abstract:**

This presentation will examine the current international laws regarding the establishment of a permanent presence on the moon, in light of NASA's bold initiative, Project Artemis, as well as how this may potentially affect the application of these laws, especially in regards to exploitation and non-appropriation. In explaining the current laws that exist as they apply to space and celestial bodies, such as the moon, I will summarize the details of Project Artemis, and project how this may impact the application of space law on an international level. Project Artemis marks the return of mankind to the moon, attempting to land astronauts on the moon for the first time in over 46 years, not to mention the first woman. Currently, Artemis is broken down into three main stages, with the eventual mission of placing a functional lunar station, the "Gateway", in orbit around the moon. From here, crewed human space capsules could easily move between the station and moon's surface, and would facilitate exploration of the moon and its resources, as a more permanent presence could be established and supplied on the surface. The Gateway would mark the first permanent station around a celestial body, leading to the question of how this will impact space law, and the applicability of provisions such as the exploitation of resources, or visitation rights. The Outer Space Treaty acts as the major body of international law regarding space activities, and establishes a cooperative effort to maintain space as a free environment for the betterment of mankind. Yet, due to the exclusive and difficult nature of space, many provisions of the treaty have little state practice, and thus, remain ambiguous. With each step forward that mankind takes in exploring the space domain, the law will inevitably follow, and establish the nature of how space activities will be conducted.



# Department of Management

## The Black Box of Executive Decision-Making

C1C Connor Stevens

Faculty Mentors: Dr. Cynthia Cycyota and Capt Elizabeth Dale

### Abstract:

The role of the Chief Executive Officer (CEO) is one of a multifaceted figurehead responsible for the culture and success of the organization they lead. Although it is nearly impossible to distill the essence of CEO success, Don Hambrick and colleagues pioneered research on what he calls the Upper Echelons Theory. This theory suggests that an executive's background and experiences influence the way they think about decisions and therefore organizational outcomes. After many years of exploring the 'black box' of executive thinking about organizational decisions without definitive results, researchers are still seeking insights into how the events in a top tier executives' life shape the characteristics for organizational success. This study uses publicly available information such as interviews, articles, biographies, news accounts, company financial data, and other archival information to explore executive influences with the end goal or potential insights into CEO success, overlooked characteristics of a CEO, or maybe even a peak into the illusive 'black box' of executive decision-making.



## Integrated Mission Management Customer Satisfaction Assessment Methodology

C1C Reese Gillan, C1C Austin Logan, and C1C Yann Wollman

Faculty Mentors: Lt Col Johnathon Dulin, Lt Col Gregory Steeger, and Maj Michael Phillipich

### Abstract:

The timeliness and accuracy of gathered intelligence is critical to mission success. To address this need, the Defense Intelligence Agency is developing an agile software program, the Integrated Mission Management System, to streamline the intelligence gathering process. This process is currently fragmented across several platforms which are not providing the capabilities needed by the warfighter, as evidenced by 22 critical intelligence data processing gaps that exist today. Throughout the development of the System, measurements of both the user community's product satisfaction and intelligence collection improvement will be extremely valuable to senior leaders and developers as the program evolves. To meet this objective, we will develop an assessment methodology that measures, over time, the System's impact on the user.



# Department of Political Science

## How Political and Partisan Attitudes Affect Justification of Political Violence

C2C Katelyn Balke

### Abstract:

Why are some people more likely to believe political violence is justifiable than others? The majority of analysis related to this question relies on variables such as exposure to violent methods, traumatic experiences, natural aggressive tendencies, etc. that explain unconscious or subconscious bias towards political violence. I used data from the American National Election Studies (ANES) 2016 Time Series dataset to measure variables in which individuals are conscious of their positions in order to explain variance in attitude towards political violence. The results show that measures of trust towards politicians, external political efficacy, and strength of partisanship identity have an effect on the degree to which Americans find political violence justifiable.



## The ECCC: The Law and its Impact

Rocco Sangataldo

### Abstract:

From 1975 to 1979 Cambodia experienced a horrific genocide under the rule of Pol Pot and the Khmer Rouge. Approximately 1.7 million Cambodians perished by the means of torture, starvation and outright murder. Though these acts were truly horrific and ones that still affect Cambodia today, it was the absence of justice served to these scarred people that will be focused upon. The Extraordinary Chambers in the Courts of Cambodia (ECCC) was a tribunal established to try the members of the Khmer Rouge that led this genocide. The biggest flaw concerning this court is the fact that it was established over 25 years after the genocide concluded. Secondly, it has only convicted three people who were involved within the Khmer Rouge. Finally, it is insanely costly to function, hence effectively wasting money for Cambodia and the United Nations. The first topic that I will cover in my presentation is the ECCC and how it functions. This first section

will be more law-oriented in order to paint the picture of what the ECCC actually does. The ECCC is a hybrid court, which makes it different than other well-known tribunals such as Rwanda and Nuremburg. Furthermore, the efficiency of the court will be covered. This applies to its unnecessary cost, why so few of people have been tried and the role that the United Nations and Cambodia play in the convictions and trials. That then merges to the political science side of the topic. Considering the fact that this court is so notoriously inefficient, it is necessary to figure out why. This brings in political culture in Cambodia and how it got mixed in with the ECCC. Finally, the Cambodian people's perception of the tribunal will be discussed. It is evident that the citizens who were subjected to this genocide are not obtaining the justice that they deserve. This once again directly correlates with the political science side of the subject and how it truly does matter for these people. Overall, the ECCC is a court that is seen as a failure by many scholars. In this presentation I will effectively try to hash out these failures and expose why the ECCC is the way it is, for better or for worse.

### **Secularism Regression**

**C2C Luke St. Pierre**

#### **Abstract:**

Why are some people more secular than others? Religion has always played a formative role in any society's culture and politics. Yet throughout the past several decades, an adherence to traditional religious practices has undeniably experienced a notable decline. Understanding motives for the retention or abandonment of conventional religious thought can have far-reaching effects, not only for domestic and international politics, but for the nature of mankind. However, discovering what drives this secularity remains hidden in a cloud of ambiguity. Of course, numerous factors influence religious-secular trends, but their significance can be difficult to pinpoint. Using country-level data from the 2010-2014 World Values Survey, an OLS regression model is used to create un-standardized coefficients that will allow for relative comparisons through effect sizes. The effects for democracy, human development, and education levels were analyzed to test how one's home country influences their self-identified level of secularity. It was discovered that an increase in human development causes an increase in secularity, but education and democracy levels do not produce the anticipated shift.

### **What Predicts the Rise of Authoritarian Rulers?**

**C2C Lindsey Licciardi**

#### **Abstract:**

The preference for autocratic leaders has led to recent fears of democratic backsliding and the erosion of democratic institutions such as individual freedoms. This paper examines the current tendency towards electing strong, authoritarian-style leaders across the globe, and



seeks to determine the cause underlying this trend. Using the data from the 2010-2014 World Values Survey, this paper measured how the rise of populism coincided with the preference for authoritarian leaders. To measure populism, this paper examined three core assumptions that predict an increase in populism's popularity: economic insecurity, lack of cosmopolitan feeling, and negative feelings towards immigrants. I predicted that each of these measures would result in an increased preference for autocratic leaders. I ran an ordinary least-squares (OLS) regression analysis to study the relationship between these variables and how they explain the connection between populism and the preference for strong, authoritarian-style leaders.

## **Out-Group Threat or Out-Group Bias: Islamophobia**

**C2C Hallie Cain**

### **Abstract:**

This paper seeks to explain the variance in prejudicial attitudes toward Muslims in the United States. Following the horrific attacks on September 11th, 2001, much of the American conscience has been dedicated to eradicating terrorism in the Middle East. Seemingly, these anti-terrorism efforts have had an unintended consequence: an increase in Islamophobia among non-Muslims in the United States. This paper analyzes whether perceived out-group threat or a simple out-group bias explains more of the variation in prejudicial views toward Muslims. Essentially, why are some Americans more Islamophobic than others? This perceived increase in Islamophobia is very concerning to all those in favor of a society based on equality, and it is important to understand the causes of prejudice toward Muslims in order to best mitigate them. To explain the variance in Islamophobia, this paper analyzes two different theories. The first is the out-group threat theory, which suggests that Americans hold prejudicial views toward Muslims because of the threat of terrorist attacks conducted by Islamic extremist groups. The second is the out-group bias theory, which suggests that Americans hold prejudicial views toward Muslims because they are both culturally and ethnically different from the majority of the population, which is predominantly white and Christian. One multivariate regression was run to measure the relationship between the fear that a terrorist attack will occur in the next 12 months and an individual's feelings toward Muslims. A second multivariate regression was run to measure the relationship between how important being white was to the respondent's identity and whether the respondent believes the Bible is the word of God or of men (two independent variables) and an individual's feelings toward Muslims. Both regressions demonstrated negative relationships between the independent and dependent variables. While both models were statistically significant, the model based on simple out-group bias was more substantively significant, meaning that out-group bias explains more of the variance in prejudicial attitudes toward Muslims than the perceived threat of Muslims.



# Department of Physics

**Follow-up Candidate Exoplanet Transit Observations Identified by NASA's TESS Spacecraft**  
C1C Kayla N. Brown, C1C Gabrielle R. McClelland, C1C Michael C. Jacoby-Dorta, C1C Casey L. Kowalski  
Faculty Mentor: Dr. Devin J. Della-Rose

## Abstract:

This research conducts follow-on observations for several exoplanet candidates from NASA's Transiting Exoplanet Survey Satellite (TESS), exploring the compositions, atmospheres, and orbital dynamics of planets beyond the solar system. TESS is a two-year, full-sky survey designed to detect over 1,600 planets smaller than four Earth radii. This is a coarse survey requiring detailed ground-based follow-up observations such as our research. We will use the 1-meter reflecting telescope located at the U.S. Air Force Academy Observatory to collect light curves of TESS exoplanet candidates, followed by differential photometry analysis using the industry standard software AstrolmageJ. Our results will be shared with the TESS seeing-limited photometry analysis team to help determine whether a specific candidate is an actual planet.





## **Characterization of Unresolved Satellite Imagery Using Near-Simultaneous Polarimetry and Spectroscopy Data**

**C1C Lucy A. Zimmerman, C1C Sequoia S. Chun, C1C Marco F. Pirozzoli**

**Faculty Mentors: Francis K. Chun, Michael K. Plummer, Cameron N. Harris**

**Industry Mentor: David M. Strong, Strong EO Imaging, Inc.**

### **Abstract:**

The Department of Physics at the United States Air Force Academy has a 16-inch telescope outfitted with a 9-position filter wheel populated with broadband photometric filters (Johnson-Cousins B, V, and R; and a blue-blocking exoplanet filter), linear polarization filters ( $0^\circ$ ,  $45^\circ$ ,  $90^\circ$ ,  $135^\circ$ ), and a 100 lines per millimeter diffraction grating. This telescope is used by Academy cadets to develop new methods of characterizing space objects using unresolved optical imagery. In the past using this telescope and filter wheel set, we have observed geosynchronous (GEO) communication satellites either photometrically, spectrally, or through polarized filters, but we have never observed these satellites in a near simultaneous fashion through more than one of those optical modes. For this research, we use two modes of analysis, polarimetry and spectroscopy, to characterize several GEO communications satellites which cannot be resolved with ground-based optical imagery due to their size and distance. The spectral analysis is accomplished through slitless spectroscopy using the diffraction grating, while the polarization analysis is achieved through the measurement of the linear Stokes parameters of satellite optical signatures using the polarization filters. This analysis compares the spectra and polarization signatures collected from glints off of operational GEO communication satellites around the spring 2020 equinox. We correlate these data with each other to evaluate whether polarimetry and spectroscopy measurements can be used together to more fully characterize the physical traits and surface properties of satellites from unresolved imagery.

## **Psychological Effects of Radiation Exposure Awareness in Military Personnel**

**C3C Jonathan Soferr, CW**

**Faculty Mentors: Captain Zachary T. Condon**

### **Abstract:**

Standard radiation detection protocols require radiation workers to wear a personal dosimeter to keep track of the amount of radiation they are exposed to. Typically these dosimeters are worn over a three month period and sent to a central organization for evaluation, which provides no real time indication of the radiation dose received. The US Army is adopting a personal dosimeter, developed by Mirion Technologies, that has a display to show the wearer's total whole-body dose in real time. This will enable personnel to make decisions concurrent with the safety of

their environment when responding to radiological events or working with nuclear technology. However, an unintended side effect of such awareness is the possible psychological ramifications of seeing changes in whole-body dose. Such a topic has only sparsely been investigated, and has never been looked at with military personnel. With the widespread use of nuclear material in all services and the increasing risk of a hostile radiological event, the armed forces would greatly benefit from understanding how troops will respond when knowingly exposed to radiation. Using an in-lab stress test with different radiation detection devices, this study predicts that a real time radiation monitor caused a detrimental effect in the person's ability to perform their assigned task which, operationally, will prove dangerous for those in hostile environments.

### **Developing a Spectral Numerical Weather Prediction Model as a Teaching Tool for Undergraduate Atmospheric Dynamics Courses**

**C1C Brandon W. Hoy**

**Faculty Mentor: Lt Col Robert S. Wacker**

#### **Abstract:**

Meteorology majors at the Air Force Academy take two semester-long atmospheric dynamics courses which introduce fundamental atmospheric dynamics concepts as well as numerical weather prediction (NWP) techniques. Currently these courses culminate in a project requiring cadets to write and execute on their personal computers a single-layer barotropic primitive equation gridpoint NWP model. The model is limited to a relatively small domain and is hampered by a simplistic treatment of boundary conditions. Spectral NWP models are designed for a global domain and so overcome the boundary condition problems, but at the cost of greater complexity of coding. The purpose of this project is to evaluate the feasibility of developing a single-layer barotropic primitive equation spectral NWP model for use as a final project in atmospheric dynamics courses. The model developed is within cadets' ability to code and is executable using the relatively limited resources available on cadets' personal computers.

### **Polarimeter Calibration and Observations of Unresolved Satellite Imagery**

**C1C Marco F. Pirozzoli and C1C Lucy A. Zimmerman**

**Faculty Mentors: Michael Korta, 2d Lt Adrian D. Scheppe, Dr. Francis K. Chun, Maj Michael K. Plummer, Capt Cameron N. Harris**

**Industry Mentor: David M. Strong, *Strong EO Imaging, Inc.***

#### **Abstract:**

Cadets and Faculty in the Department of Physics at the United States Air Force Academy developed a calibration process to determine optical elements' impact on the polarization of



incident light for a DFM Engineering f/8.2, 16-inch telescope. Using an Alnitak Flatman light source, as well as polarized film rotated at 10° increments, light intensities were passed through 0°, 45°, 90°, and 135° analyzer filters sequentially. Observed intensities were fit to Malus' Law using the Levenberg-Marquardt least squares method, generating coefficients that comprised a modified Mueller matrix. The matrix describes the alterations to Stokes vectors ( $S_0$ ,  $S_1$ , and  $S_2$ ) as the light passes through the optical system. In order to relate the measured intensities of light to the Stokes vectors as they reflect off of the satellite, we calculated a calibration matrix using a Moore-Penrose pseudoinverse of the modified Mueller matrix. The sensitivity of the pseudoinverse process was analyzed by perturbing input data and measuring the error between the Stokes vectors generated directly from intensity measurements and those computed using the pseudoinverse. It was demonstrated that this process for employing the pseudoinverse introduced minimal error into the system. Once the method's sensitivity was quantified, the resulting calibration matrix was applied to geosynchronous satellite observations taken during the Spring and Fall 2019 equinox periods, further validating the calibration process through the analysis of each vehicle's polarization signature.

### **Using Tapered Optical Nanofibers to Construct a Dye Laser**

**C1C Michael Jacoby and C1C Casey Kowalski**

**Faculty Mentors: Dr. Rajani Ayachitula and Dr. Brian Patterson**

#### **Abstract:**

Optical nanofibers are optical fibers that have been adiabatically tapered down to an approximate 1-micron diameter. The strong evanescent field they produce has a variety of applications including sensing, atom trapping, and novel laser designs. Of particular use to the Air Force are the atom trapping capabilities, as they could prove useful to the Air Force's ongoing research on quantum information science, and constructing a fiber-based alkali laser. Our research focuses on the production of tapered nanofibers in order to construct a rudimentary dye laser. Light from a 520-nm diode laser is focused into a single-mode tapered nanofiber which has been submerged in rhodamine 6G laser dye. The evanescent field interacts with the dye, resulting in stimulated emission which is coupled back into the fiber. Mirrors on either end of the fiber provide the necessary feedback for lasing. By constructing this dye laser, we attempt to refine a reliable process of both tapering and focusing light into the fiber so that these processes might be used in later, more complex experiments.

## Photophysical Properties of a Digold(I) Complex

C1C Daniel J. McIlhenny

Faculty Mentor: Dr. Kimberly de La Harpe

### Abstract:

We will report on the photophysical properties of a novel digold(I) complex consisting of a benzothiazole-2,7-fluorenyl moiety bound to N-heterocyclic carbene ligands via gold(I)-carbon  $\sigma$ -bonds. This complex absorbs in the ultraviolet and exhibits dual fluorescence and phosphorescence in the visible range at room temperature, making it of interest as an OLED. The ground-state and excited-state properties of this complex will be compared with a similar monogold(I) system to understand how an additional gold impacts excited-state dynamics.

## The New and Improved Digital Holography Demonstration System

C2C Ryan Schneider and C1C Connor Vikupitz

Faculty Mentor: Maj Casey J. Pellizzari

### Abstract:

In order for the US Air Force (USAF) to maintain its advantage over near-peer adversaries, it is investing in lasers and optics research. The Department of Defense (DOD) plans to use these laser and optical systems for long-range imaging and reconnaissance as well as missile defense and targeting. In order to revolutionize the field, the USAF needs a pool of scientists and engineers who understand the practical applications of lasers and optics. Many students are unaware of the theory and applications of this cutting edge field, hence the need for a demonstration tool such as the Digital Holography Display (DHD). The original purpose of the DHD was to exhibit complex principles in lasers and optics to better expose students to these important concepts at the forefront of science. Recently, updates have been made to make the DHD more interactive. Through increasing the interactivity of the DHD, students can manipulate the system to better discover the basic principles of light, wave interference, and even more advanced concepts such as holographic imaging and the effects of atmospheric turbulence.





## **Simulating Dynamic Atmospheric Turbulence in the Digital Holography Demonstration System**

**C1C Connor Vikupitz**

**Faculty Mentor: Maj Casey J. Pellizzari**

### **Absract:**

The Air Force is heavily invested in the potential use of lasers in many areas. One example application is the use of Digital Holography for remote sensing. In Digital Holography, we use a laser to illuminate an object then mix the returning light with a reference laser. As a result, we obtain information about the intensity of the light and its phase. The phase provides information for three-dimensional imaging and information about atmospheric turbulence which can be used to fix blurry images. The Digital Holography Demonstration (DHD) system was developed as a way to communicate this complex topic as part of STEM outreach activities. However, in its current state the DHD lacks the capability to simulate real-time atmospheric turbulence. As a result, audiences may find it difficult to fully grasp the ideas that are being presented. To fix this issue, we have modified the DHD to simulate real-time atmospheric turbulence. This required a redesign of the optical system and inventing a tool to simulate dynamic atmospheric turbulence.

## **Initial Calibration of Multiple Optical Telescopes in Support of a Joint US-UK Space Situational Awareness Observational Campaign**

**C2C Ethan M. Albrecht**

**Faculty Mentor: Dr. Francis K. Chun Industry Mentor: David M. Strong, *Strong EO Imaging, Inc.*, and Casey P. Schuetz-Christy, *Millennium Engineering & Integration Co.***

### **Abstract:**

Many different efforts are ongoing in the use of ground-based optical observations for characterization of space objects and space object identification. However, many of the observations are typically conducted in one modality, i.e. photometry to produce a space object's light curve. The Center for Space Situational Awareness Research (CSSAR) in the Department of Physics at the United States Air Force Academy (USAFA) has been developing additional satellite characterization capabilities in slitless spectroscopy and polarimetry, and is involved in a joint observational campaign with the University of Warwick (UW), United Kingdom. CSSAR and UW just initiated an observational campaign using multiple telescopes that will collect simultaneous, multi-modal data on geosynchronous (GEO) satellites (both stable and inactive). The collected data will be used to determine how features in one mode (e.g. photometric light curve) compare and correlate to features in another mode (e.g. polarimetry), and ascertain an optimal set

of inputs to develop a unique fingerprint for each satellite. This presentation provides initial analysis on observation data of a standard set of GEO satellites and Landolt calibration stars taken by a number of geographically dispersed USAFA telescopes in order to accurately calibrate their measurements.

### **Construction of a Hydrodynamic Pilot Wave Analog Experiment**

**C2C Nicolette Clark**

**Faculty Mentor: Lt Col James Scoville**

#### **Abstract:**

Approximately fifteen years ago, Yves Couder discovered a macroscopic system which demonstrated quantum-like phenomena through a mechanism reminiscent of Louis de Broglie's Pilot Wave Theory. This system involves a millimetric oil droplet bouncing across the surface of a vertically vibrating oil bath. The bouncing oil drop system offers insights toward visualizing and understanding quantum behavior. We here present the results of a semester project to build an experimental setup allowing for further exploration of hydrodynamic quantum-like behavior. This project includes an overview of the function and construction of all key components of the setup, with a focus on the assembly of a piezoelectric droplet generator.

Understanding Dirac and Weyl Fermions, Helicity, and Chirality C2C Colin Maloney, C2C Mai Le, and C2C Samuel Angus Faculty Mentor: Lt Col James Scoville

**Abstract:** We present a straightforward way to understand Dirac and Weyl fermions, helicity, and chirality. We show that Weyl spinors are a natural way to introduce the matter content of the Standard Model, the role the Higgs boson plays in giving particles mass, and the unfamiliar structure of Dirac equation. We present an easy way to visualize the difference between helicity and chirality.

### **Radioxenon 2D Beta-Gamma Spectrum Analysis**

**C1C Jefferson Sesler and C1C Jordan Armstrong**

**Faculty Mentors: Thienbao Carpeny and Lt Col James Scoville**

#### **Abstract:**

Detecting atmospheric xenon radioisotopes, in particular  $^{131m}\text{Xe}$ ,  $^{133}\text{Xe}$ ,  $^{133m}\text{Xe}$  and  $^{135}\text{Xe}$ , can provide "smoking gun" evidence of underground nuclear tests. Current International Monitoring System radioxenon sensors rely on beta-gamma coincidence counting to detect and quantify the isotopes of interest. The analysis software in these systems rely on Region of Interest counting for quantification. This technique, though simple to execute, is especially sensitive to gain



shifts in energy calibration of the detector, which can lead to mismeasurements and challenges detecting the metastable isomers. To address these issues we demonstrate proof-of-concept algorithms using 2D spectral fitting and machine learning. We aim to develop a more robust and reliable algorithm for the upcoming generation of beta-gamma sensors.

### **Progress on Developing the Xenon Atom Trap Trace Analysis (ATTA) System for the Measurement of Xenon Radioisotopes**

**C2C Zachary J. Eyler, C2C C. Peirce Goldtrap, C2C Lindsay Powley, C2C Daniel Reinfurt, C1C Philip Rich, and C2C Gunnar Schultz**

**Faculty Mentors: Capt Logan J. Brandt and Dr. Randy Knize Industry Mentor: Michael K. Shaffer, *Shaffer Consulting Inc.***

#### **Abstract:**

There is currently a high interest in the measurement of airborne Xe radioisotopes. Two common methods for measuring Xe radioisotope concentrations are  $\beta$  -  $\gamma$  coincidence counting and High Resolution Mass Spectroscopy, both of which have limitations. As an alternative, we have been developing the Xenon Atom Trap Trace Analysis (ATTA) system, based on laser cooling and magneto-optical trapping (MOT) techniques, capable of increasing the detection sensitivity by an estimated 2+ orders of magnitude. This past year we have successfully demonstrated a Xe MOT, individually trapping and quantifying the nine naturally abundant isotopes of Xe. For noble gas MOTs, there are significant trapping efficiency losses due to state and collimation. To recover our efficiency, several techniques are currently being implemented, including a tunable Zeeman slower, an in-vacuum excited Xe generator, improved ion and photon detection and most importantly the recirculation of Xe gas. Recirculating the Xe gas will not only contain valuable samples, but is also critical for allowing the extended time to perform the needed spectroscopy on Xe radioisotopes in the lab. We will report on our progress on each of these improvements and the current capabilities of the Xe ATTA system.

## **An Estimation of the Isotope Shift and Hyperfine Splitting in the $6s\ 3/2\ [3/2]_2$ AND $6p\ 3/2\ [5/2]_3$ STATES IN $^{131m}\text{Xe}$ , $^{133}\text{Xe}$ , $^{133m}\text{Xe}$ , and $^{135}\text{Xe}$**

**C2C Jacob C. DeLange**

**Faculty Mentors: Capt Logan J. Brant and Dr. Randy Knize Industry Mentor: Michael K. Shaffer, *Shaffer Consulting Inc.***

### **Abstract:**

There is currently a high interest in the measuring of Xenon radioisotopes,  $^{131m}\text{Xe}$ ,  $^{133}\text{Xe}$ ,  $^{133m}\text{Xe}$  and  $^{135}\text{Xe}$ . There are currently two common methods capable of measuring nuclear Xe concentrations,  $\beta - \gamma$  coincidence counting and High Resolution Mass Spectroscopy. Both of these have limitations, particularly in regards to distinguishing between the nuclear isomer and ground states. Recently, we have begun development of the Xenon Atom Trap Trace Analysis (ATTA) system, based on laser cooling and magneto-optical trapping (MOT) techniques, which shall offer increased isotope/isomer selectivity and counting sensitivity beyond either of the current methods. The Xe ATTA system utilizes energy shifts to the trapping transition to distinguish between Xe isotopes. This impressive selectivity is largely due to the isotope shift and hyperfine splitting that slightly shift the energy of  $882\text{nm}$ ,  $6s\ 3/2\ [3/2]_2 \rightarrow 6p\ 3/2\ [5/2]_3$  trapping transition. While these values and spectra are well known for the 9 stable isotopes of Xe, they are not known for the 4 radioisotopes of interest. To guide an anticipated spectroscopic investigation, estimates of the unknown hyperfine spectra and isotope shifts are calculated for radioxenon. Results for all estimated shifts will be presented in detail during the presentation.

## **The Advantages and Disadvantages of Event-based Sensing Versus CCD Sensing for Space Situational Awareness**

**C2C David H. Howe**

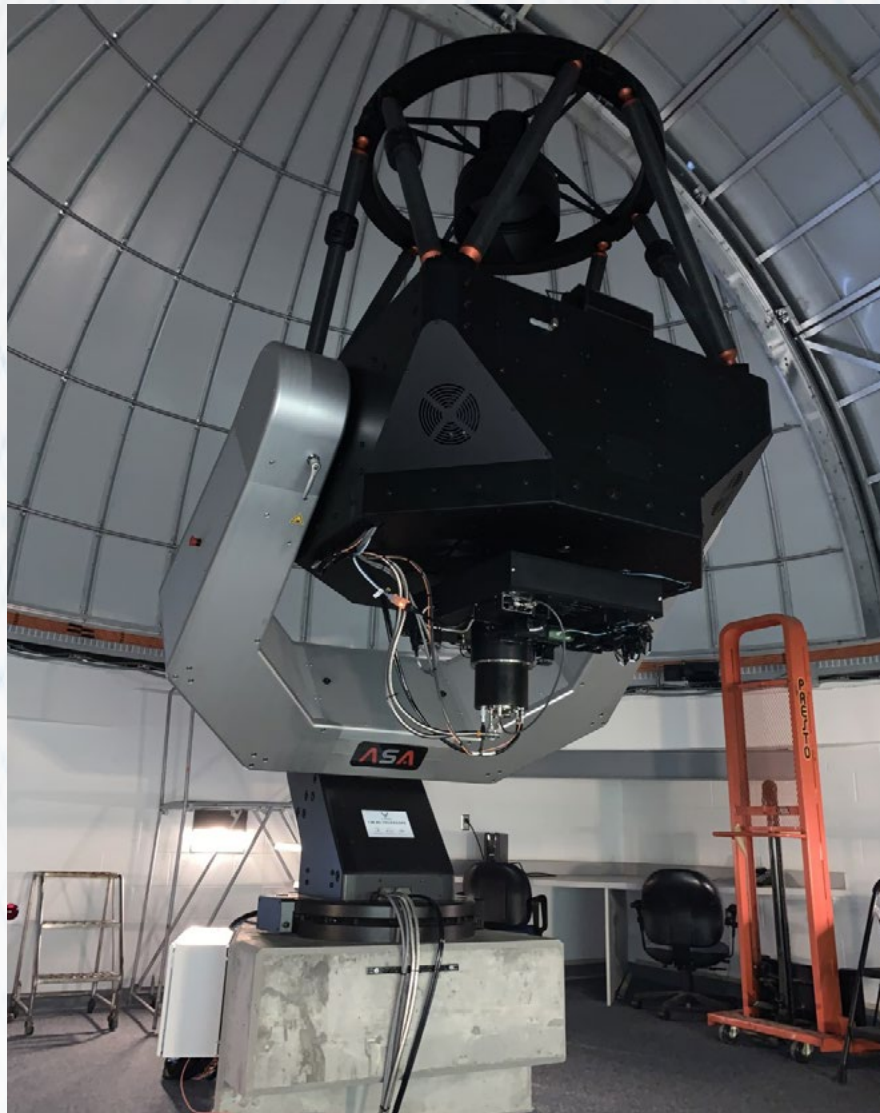
**Faculty Mentors: Maj Brian J. McReynolds and Dr. Francis K. Chun**

### **Abstract:**

Research on event-based sensing has advantages that may be helpful in Space Situational Awareness (SSA). Currently, charge-coupled device (CCD) sensing is the primary way to optically track and monitor the orbit of satellites. CCDs work by converting the photons incident onto a pixel into an electronic signal in order to create an image. In order to analyze the orbit of the satellite of interest, CCD images are taken with satellites streaking across the image with a background of stars for reference. Event-based cameras work by sensing a change in intensity of a pixel. A neuromorphic camera is one example of event-based sensing and the technology is



motivated by how neurobiological sensors like our eyes process signals. Biological sensors, like our eyes, draw attention to movement. In the same sense, neuromorphic cameras only detect changes in a scene and thus reports location and the change associated with a pixel, while CCDs have to save the entire image. Only saving location and change saves a significant amount of storage over storing the whole image. Because neuromorphic cameras and event-based sensing only track changes in pixels, the object has to be moving for neuromorphic cameras otherwise nothing is sensed. While neuromorphic cameras are only able to detect dynamic images, CCDs have the ability to sense dynamic and static images. Other benefits of Event-based sensing include obtaining higher framerates, consuming less power, requiring less memory, and having a higher dynamic range. Another advantage of Event-based cameras is the ability to track satellites during day and night without modifications to the camera.



*The views expressed are those of the authors and do not reflect the official policy or position of the U.S. Air Force Academy, The U.S. Air Force, The Department of Defense, or the U.S. Government.*

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ENHANCING CADET EDUCATION  
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