**High Altitude Balloon Demonstration of a Radiation-Induced Random Number Generator**

**F18/S19 Capstone Description  
Interdisciplinary (2 ME/MET + 2 EE/CpE)  
Sponsor: NASA  
Advisor: Brock LaMeres (ECE)**

**Project Summary**

This capstone project will design a high-altitude balloon payload to conduct a technology demonstration of a random number generator. The technology that will be demonstrated exploits the vulnerability of modern Field Programmable Gate Arrays (FPGAs) to ionizing space radiation. When radiation strikes an FPGA, they cause unwanted logic transitions (i.e., 1’s become 0’s and vice versa) known as *Single Event Effects* (SEEs). Though SEEs can cause computers to crash and great lengths are taken in space systems to mitigate them, this technology instead takes advantage of the external nature of these faults to create truly random seed numbers for use in encryption keys. The weakness of modern encryption standards is not necessarily in their mathematical complexity, but rather in the predictive data patterns that arise due to using encryption keys that are not truly random. This allows attackers to narrow down their key search to those that could be related to the patterns emerging in the data stream. Thus, a technology that can generate truly random numbers in a lightweight, silicon-based form factor can greatly improve both the security and authentication of satellite communication links. The payload will be designed to carry an FPGA onboard a *World View Strato-Craft* balloon platform to expose the system to a relevant environment. This long duration (~8 hours) high altitude (>30km) test will allow the number generator technology to be bombarded with ionizing radiation without the protection of the Earth’s atmosphere and characterize experiments related to the randomness and rate of the SEE generated keys. This NASA-sponsored flight is scheduled for August of 2019, so the final capstone deliverable will be a payload that is flight-ready. This is an interdisciplinary project that will consists of both mechanical and electrical sub-systems. The mechanical subsystem will need to protect the experiment from the extreme temperature swings experienced on high-altitude balloon missions and also adhere to the mechanical interface requirements of the Strato-Craft balloon system. The electrical subsystem will need to interface with the Strato-Craft balloon system to receive power for the experiment in addition to commutating with the balloon platform to downlink experiment data.