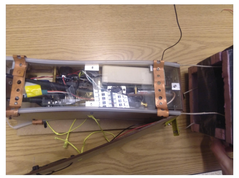
Flying “Mock” CubeSats on Stratospheric Balloon Flights:

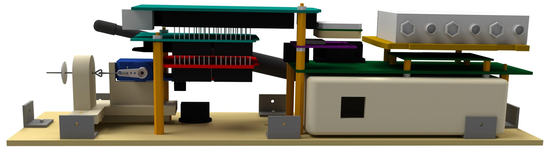
An Update about “Mock P-PODs” and the 3U “MOC-SOC”

Paul Wehling, Andrew Van Gerpen, and James Flaten (Faculty Advisor)
University of Minnesota - Twin Cities

Why Mock CubeSats?

CubeSats are a standardized form for relatively cheap access to space. Flying mock CubeSats aboard stratospheric balloons gives students experience designing and flying with more complex systems than many traditional stratospheric payloads, and is a good way to challenge and train university engineering teams.





Left, an image of MOC-SOC on the workbench showing its rigging pipes and clear side for troubleshooting and display. Right, a rendering of the major components of MOC-SOC mounted on its removable wall.

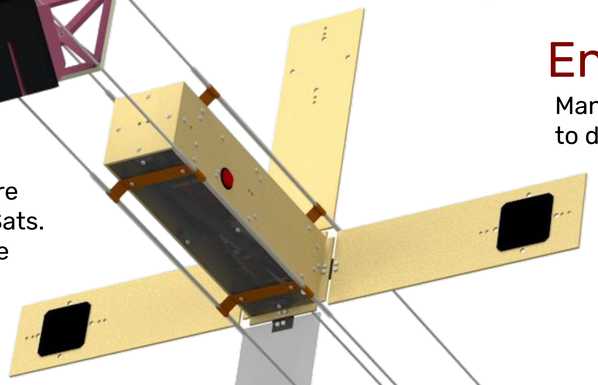
Flying Rough: Designing Durability

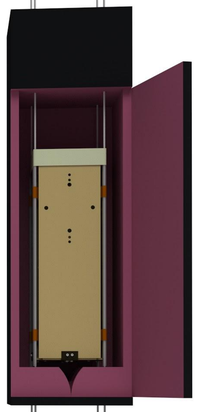
Many of the recent upgrades to MOC-SOC and P-POD have been strengthening both hardware and software for flight in the stratosphere, which presents unique challenges to mock CubeSats. MOC-SOC has had to forego structural techniques used on space-faring CubeSats to become more resistant to turbulence and landing shocks, which are particularly intense for a hard-shelled payload. In addition, the radio telemetry system has received major overhauls and ground testing to allow changes to mission profile after launch and provide good connection in flight, despite limitations to the radio system presented by the specialized payload shape.

P-POD and MOC-SOC: Systems Overview

MOC-SOC and mock P-POD are a pair of stratospheric ballooning payloads designed to emulate the design and functionality of a CubeSat and CubeSat deployer, respectively, that traditionally operate in low Earth orbit while flying at a much reduced cost and turnaround time. Last year, our team presented about the development of mock CubeSat ballooning capabilities and their uses to university students and teams. Since then, we’ve continued development of these two payloads, and have learned much about both the possibilities and limits of flying mock satellites on stratospheric balloons.

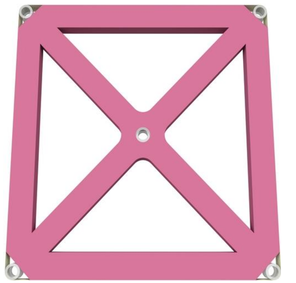
MOC-SOC, the main sensor payload, carries onboard a Geiger counter, a small set of solar panels for measuring solar flux for future solar-powered flight, short and long-range radios, a GPS unit, and a temperature sensor. MOC-SOC spends much of balloon ascent within the mock P-POD, insulated from the outside conditions. As the balloon stack reaches the upper atmoshphere, P-POD ejects its payload(s), and shortly after MOC-SOC deploys its solar panels, much like space-faring CubeSats ejected from P-PODs or the International Space Station.





Ensuring Reliable Deployment

Many of the recent changes to MOC-SOC and P-POD have had to do with increasing ejection and deployment reliability. Not surprisingly, redundant deployment triggers have greatly aided reliability, but solutions also had to be found for more novel problems, including tangling and winding of the lines below P-POD onto which MOC-SOC deploys, necessitating the design of rigging spacers (right).



From left to right: Preparing of the anti-tangling rigging system before a launch, the design of one of the foam and tubing spacers that makes up the system, and a diagram showing MOC-SOC stowed in P-POD as it would be during ascent with the spacers beneath. Above, a rendering of MOC-SOC after ejection and deployment.

Acknowledgments:

This project was funded by the Minnesota Space Grant at the University of Minnesota - Twin Cities and supported by the Department of Aerospace Engineering and Mechanics.

Thank you to Jordan Bartlett, Emma Krieg, and Ryan Bowers for their work on the original MOC-SOC and mock P-POD project, and to the University of Minnesota SmallSat team, Billy Straub, Donald Rowell and Lilia Bouayed for their contributions to MOC-SOC.