DRAGONS – A Micrometeoroid and Orbital Debris Impact Sensor

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The Debris Resistive/Acoustic Grid Orbital Navy Sensor (DRAGONS) is intended to be a large area impact sensor for in-situ measurements of micrometeoroids and orbital debris (MMOD) in the ~0.2 to 1 mm size regime. These MMOD particles are too small to be detected by ground-based radars and optical telescopes, but still large enough to be a safety concern for human space activities and robotic missions in the low Earth orbit (LEO) region. The nominal detection area of DRAGONS is 1 m^2, consisting of four 0.5 m × 0.5 m independently operated panels. The concept of the DRAGONS design is to combine three different detection technologies to maximize information extracted from each detected impact. The first technology is a resistive grid consisting of 62.5-µm-wide resistive lines, coated in parallel and separated by 62.5 µm gaps on a Kapton film. When a particle a few hundred micrometers or larger strikes the grid, it world penetrate the film and sever some resistive lines. The size of the damage area can be estimated from the increased resistance. The second technology employs a dual-layer, 25-µm-thick Kapton film with a 10 cm separation. By measuring the time difference between impacts on the two films, the impact speed can be calculated. The third technology is based on polyvinylidene fluoride (PVDF) acoustic impact sensors. Multiple PVDF sensors are attached to the backside of both Kapton films to provide impact timing measurements. The impact location on each film can be identified from the triangulation of signals received at different PVDF sensors and provides an estimate of the impact direction.

The development of DRAGONS is supported by the NASA Orbital Debris Program Office. The project is led by the U.S. Naval Academy (USNA), with additional collaboration from the U.S. Naval Research Laboratory (NRL), the University of Kent at Canterbury in Great Britain, and Virginia Tech (VT). The short-term goal of DRAGONS is to advance its Technology Readiness Level to 9 and to demonstrate the system capabilities of detecting and characterizing sub-millimeter MMOD impacts. The long-term goal is to deploy a large detection area (>1 m^2) DRAGONS to 700-1000 km altitude and collect sufficient data for better environment definition of MMOD in the 0.2- to 1-mm size regime. The Preliminary Design Review (PRD) of DRAGONS was held at the USNA in June 2012. The Critical Design Review (CDR) is scheduled for early 2013. A flight-ready unit with a 0.25 m^2 detection area will be completed and tested by the end of September 2013. The biggest challenge for the project, however, is to identify a demonstration opportunity on the International Space Station in the coming years.