UML Researcher's Work Keeps Space Station Crew Safe

Data Will Help Plan Spacewalks

Have you ever experienced walking across a carpeted room and getting a shock when you reach for a metal doorknob? The culprit is static electricity, which builds up, especially in dry weather, on the surface of your body as the soles of your feet rub against the carpet. This surplus electrical potential gets discharged when you get very close to a metallic object.

The same effect is happening right now to the International Space Station (ISS) as it orbits Earth some 350 kilometers (220 miles) above the ground. As the 270-[redacted] complex travels through our planet's tenuous ionosphere, its huge solar-panel arrays continuously pick up and accumulate free electrons, a process known as "spacecraft charging." NASA is concerned that when this charge becomes too high, astronauts performing extra-vehicular activities (EVAs), or "spacewalks," could get zapped by the ISS, potentially damaging the astronaut's sensitive communications or life-support electronics, or worse.

"The ISS is equipped with special devices, called plasma contactors, that continuously discharge the Station," says Dr. Ivan Galkin, head of the UML Center for Atmospheric Research's Software Systems Section. "Nevertheless, depending on the ionosphere's plasma density, the voltage difference between ISS and surrounding space can still be 50, or even 80 volts. This is high enough to create an arcing hazard between the ISS and metallic parts of the astronaut's space suit, such as the neck and arm rings. In other words, the astronaut can get electrocuted during a spacewalk if the Station collects too much charge."

Continued from Page 1

UML Researcher's Work Keeps Space Station Crew Safe

Thanks to Digisonde sounding data provided by Galkin, Dr. William Hartman and his colleagues at Boeing, the prime contractor for the ISS, now has a new tool for predicting plasma densities in the ionosphere. This, in turn, will help NASA decide whether it's safe for astronauts to venture outside the Station.

Digisondes are portable, low-power (300-watt), ground-based transmitters that the Center built and installed in about 70 sites in the U.S., Europe, Africa, Asia, Australia, South America and Antarctica. Each instrument is capable of automatically making measurements of the ionosphere directly above its location and providing on-site processing and analysis before sending the information in near-real time to space-weather prediction centers. About 30 of these Digisonde sounders send their results to UMass Lowell's automated data repository at Wannalancit Mills.

Galkin notes that spacecraft-charging effect is especially pronounced when the ISS is close to the area of maximum plasma density, known as the F region peak, about 200 to 600 kilometers high. The main difficulty in planning EVAs, he says, is that currently available ionospheric models are not accurate enough to predict how close the ISS's orbit would be to the F region's peak altitude, which varies according to prevailing solar-terrestrial conditions. That's where data from the Digisonde global network comes in.

▲ Ivan Galkin

"According to Dr. Hartman, whenever EVAs are planned, a model is used to predict how many solar-panel arrays need to be shunted, or diverted, in order to keep the Station's electrical potential safe for the astronauts' spacewalk," says Galkin. "But the Boeing team observes that the model can suggest shunting four of the six arrays, whereas direct measurements, made by an external potential probe on ISS, don't support this requirement. Our Digisonde data will be used to improve the quality of the team's predictions by adapting the model to current space conditions. Dr. Hartman's tests on previous Digisonde data turned out very well. We started sending daily Digisonde reports to his team in March."

He adds: "Since the ISS is now equipped with a special sensor to monitor the charging, a spacewalk can be aborted if the conditions are not right."

—*EA*