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Realtime Sensing and Monitoring while Drilling Using the USDC with Integrated Sensors

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ABSTRACT

The search for existing or past life in the Universe is one of the most important objectives of NASA's mission. In support of this objective, ultrasonic based mechanisms are currently being developed at JPL to allow probing and sampling of rocks and to use the mechanisms as a sensor platform for in-situ astrobiological analysis. The technology is based on the novel Ultrasonic/Sonic Driller/Corer (USDC), which requires low axial force, thereby overcoming one of the major limitations of planetary sampling using conventional drills in low gravity environments. The USDC was demonstrated to: 1) drill ice and various rocks including granite, diorite, basalt and limestone, 2) not require bit sharpening, and 3) operate at high and low temperatures. The capabilities that are being investigated include probing the ground to select sampling sites, collecting various forms of samples, and hosting sensors for measuring various properties. The emphasis of this paper will be on the Lab-on-a-drill as a sensor platform for in-situ astrobiological exploration. Two of the sensors that were integrated include a thermocouple and a fiberoptic. A series of modifications of the USDC basic configuration were implemented leading to an ultrasonic abrasion tool (URAT), Ultrasonic Gopher for deep drilling, and the Lab-on-a-drill.