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Traction control for the Curiosity rover: A new capability to minimize slip and wheel wear on Mars

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The Mars Science Laboratory (MSL) rover has accumulated substantial damage on its wheels over the 15 km travelled so far on Mars. One reason for the wheel wear is that the rover is commanded to drive as if the terrain was flat. For example, a straight drive is achieved by commanding all wheels at the same speed. However, when one of the wheels needs to drive over a rock, that wheel needs to go faster since it needs to travel a longer distance over the same time period. Failure to do so results in that wheel going slower than it should and getting pushed into the rock by the other wheels, which can cause damage such as wheel skin puncture or cracking. In order to minimize wheel wear, a new capability was developed that adapts the speed of each wheel to minimize slip. Modulating wheel speed to match the terrain topography is a very challenging problem, especially when that topography is unknown. While the Curiosity rover can image the terrain and generate a height map, it rarely does so during a drive, as this is a time-consuming process. Moreover, the noise in the mesh and accumulated errors in the rover's pose would make it unpractical to rely on terrain topography to optimize wheel speeds. Instead, a novel approach was developed which relies only on the rover's measured attitude rates and suspension angles (from the onboard gyroscopes and rocker/bogies encoders) and leverages rigid-body kinematics to calculate the optimal wheel speeds..

Biography

Olivier A Toupet has completed his MS in Aeronautics and Astronautics from MIT in 2006. He is currently a Research Technologist in the Robotic Mobility group at NASA JPL, where he develops advanced autonomy for robotic systems. He is also a Rover Planner for the MSL flight mission, where he drives the Curiosity rover and operates its robotic arm on Mars.

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