SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

Author: Dr. Gian Paolo Candini
Instituto de Astrofisica de Andalucia, Spain

Dr. Fabrizio Piergentili
University of Rome "La Sapienza", Italy

A HEXAPOD ROVER FOR SMALL AND EDUCATIONAL EXPERIMENTS ON AUTONOMOUS NAVIGATION SYSTEM AND ALGORITHMS

Abstract

Nowadays space exploration is largely based on robotic missions and rovers for planetary researches are largely in use. A wide number of different concepts and designs for rovers manufacturing have been analyzed and used. Topics related to rover motion system and autonomous navigation are currently under investigation in many universities and research centers overall the world such as at the II Faculty of Engineering of University of Bologna where a small hexapod rover is under development with the involvement of students and researcher for educational and scientific purposes. The manufacturing of a rover with the involvement of young engineers and students represents a good opportunity to teach to the students space robotic through hands-on education and to stimulate them to propose new ideas and solutions for real problems they face. By working on a real rover development students can learn the interaction of all rover subsystem: the power unit exploiting photovoltaic cells and NiCd batteries, the on board data handling system which use terrestrial off the shelf components, telecommunication system based on S-band transmitter and the guidance navigation and control system based on proximity sensors and a radar. The paper deals with a description of rover main subsystems and sensors and with algorithms used for autonomous navigation implementation. The motion system of the rover is based on two stages: a main controller and six single legs controllers. The main controller is in charge of commanding each leg, to control the power supply to collect telemetry from all legs and to transmit it. It is capable to switch on and off each leg independently and it also provides power up to six external devices. On the other hand, each leg is designed to accept command from the controller and to operate independently performing complex movements and solving simples problems without the intervention of the main controller through feedback control over proximity sensor. For this reason, it is equipped with current and pressure sensors, contact switches and it is outfitted for other future expansions. Since all legs communicate on the same serial bus, they can listen to the traffic generated by other legs and use those information to coordinate themselves during complex movements. The radar is an infrared sensor capable to measure distances up to 1-1.5 meters installed on a 2-axys system that allows to cover up to 180 horizontally and 90 vertically with a spatial resolution up to 0.257. It has a maximum resolution of 12 bits and it can perform scan on a single line for fast obstacle detection; it can also generate an high-resolution map for accurate ground mapping. The OBDH system can transmit raw data such as collected by radar or the map itself.