New Progress on the Novel Robotics Systems for Moon Exploration

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Abstract. NOROS robotic system is on development between Politecnico of Milan and Beijing University of Aeronautics and Astronautics. Begun in 2004, it previews the planning and the construction of a prototype of a family of robots for the exploration and the exploitation of the lunar ground.

The concept of the project Noros consists in the idea of a robotic system for the exploration of the lunar ground. It is compatible with the most meaningful technologies for the space programs and for the international scenes of research and development on space.

The robot has a semispherical shape, with legs and wheels for the movement, with cameras for vision and intelligent sensors in order to recognize the environment and in order to move in every condition.

A novel design of wheel-legs rover is proposed on the tough planetary surface exploration. The structure of this rover can be changed to adapt to different exploration environment and requirements of its task. It takes the advantage of the two manners of locomotion (walking in 6-legs mode, moving in wheeled-vehicle mode). We have designed the structure of the robot. The gross prototype was built with Solidworks. It contains one body and six legs. Each leg has three joints and one wheel. We chose Maxon motor for every joint. We are designing the details of the body and legs now. Drawing is going on.

NOROS with six legs have many kinds of possible locomotion. For NOROS, we designed three types of locomotion, mammal type, reptile type and mix type. Properties of three types were researched. Mammal and reptile types are easy to control, mix is easy to realize big turning. Six legs make robot redundant locomotion system. Five legs, four legs gaits were also studied [1].

Kinematics and inverse kinematics based on geometric method is used for forward control. This simulation results in MATLAB with ROBOT model in ADAMS are shown. A good result was gained. Future work is to go on with feed-/back control that means Feed-forward plus Feed-back (FFFB) to get better result.

FIGURE 1. body displacement along x
FIGURE 2. body displacement along y
For an application in the space, a type of serial communication is not obviously thinkable between robot and lander, or also among the various robots. Insofar we go to analyze the field of the communication without cables, the Wireless. The Wireless generally uses radio waves to low power, nevertheless the definition also extends to less diffused devices that exploit the infrared radiation or the laser. The radio waves are used by the nets that must cover heterogeneous environments where the different sites to be connected necessarily are not visible, in fact they can be separate from walls. Among the technologies of communication Wireless, the three that must be analyzed for a possible use are: Bluetooth, Wi-Fi, Wi-Max.

The working prototype is in fact very useful for a first implementation of the control system and very effective in demos, but limited in term of functions and in term of mechanical behavior. A second prototype in carbon fiber is on test; it works now with a new type of batteries which are smaller, lighter and longer-lasting in Lithium Polymer, as the latest technology. The prototype is working with Wi-Fi.

An important payload is drilling system. The drilling system applied on the lunar exploration has been designed. This system is composed of two parts: the actuation structure and the rod-changing structure. The actuation structure includes two motors which will realize the translation and rotation of the drilling rods. The rod-changing structure can realize the connection of different rods. Both structures work together can complete the whole sampling task. Now we have almost finished the sketch design of the structure, and we have completed the calculation of the power and torque which are needed for the choice of motors. We are now choosing the proper motors and related accessories for the system, and we will finish the 3D structure design and simulation as quickly as possible.

REFERENCES

PRINCIPAL AUTHOR’S BIO (~50 WORDS)
Alberto Rovetta, Professor of Robotics, of Innovative Design for Intelligent Robots and Autonomous Systems, is also Guest Professor in Beijing University of Aeronautics and Astronautics BUAA, cooperates strongly with Prof. Ding Xilun, BUAA, in NOROS project, developed together, here presented.