Autonomous Navigation Research for Lunar Rover based on Fuzzy Behavior in Unknown Environment

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Abstract. Lunar rover is an important and necessary tool for moon discovery and research. The ability of autonomous navigation is vital in the lunar rover’s capabilities, which is the bottleneck for the lunar rover to accomplish the exploration and detection because of the complex environment on the moon will challenge the rover’s in all sides. Despite we can help the lunar rover to judge to navigate by telecontrol, we have to improve the rover’s ability of autonomous navigation as best we may under the limit of the sensors and the distance from the earth to the moon.

According the unknown environment’s constraints and the control architecture’s requirements, a method of autonomous navigation based on fuzzy behavior fusion is proposed. First instinct behavior and basic behavior are put forward and defined after the analysis of the artificial intelligence based on behavior. The latter are designed with fuzzy control theory, including goal-oriented behavior, emergency behavior, passing-judgment behavior, obstacle-avoidance behavior, wall-following behavior, backing up behavior, goal’s position and pose constraints behavior.

On the basis of behavior decomposition, the methods of behavior fusion is discussed. With the comparison and reference of the defuzzication methods, a center of gravity(COG) based fusion is come up to integrate the emergency behavior, goal-oriented behavior, obstacle-avoidance behavior, and wall-following behavior. And the weight-dynamically-adjusted rules are designed independently.

Finally a simulation platform is developed with Visual C++, and many complex environments are designed including blind alley, labyrinth, etc. Multi typical simulations are made, which prove the navigation strategy based on fuzzy behavior fusion based on weight-dynamically-adjusted COG method is right and reliable, and provide a solid base for the lunar rover to accomplish the task successfully. And the simulation results are shown in the following Figure 1.

FIGURE 1. This is an autonomous navigation simulation of lunar rover based on fuzzy behavior fusion.
REFERENCES


PRINCIPAL AUTHOR’S BIO

Xu Hongyan, PhD, graduated from Harbin Institute of Technology, chief engineer of Research & Development Center of China Academy of Space Technology (CAST), where he has been engaged in communication satellite general design and development. Previous work includes mobile robot autonomous navigation, fuzzy behavior fusion.