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DRL-BASED AUTONOMOUS IMAGING STRATEGY FOR SMALL CELESTIAL BODIES FLYBY

Abstract

As the distance between the spacecraft and Earth increased, large communication delay and environment uncertainties in deep space make it hard for spacecraft to image at right point during a flyby mission of the small celestial body. Aiming at the imaging problem under such situation, an autonomous imaging strategy is proposed in this paper. The strategy is generated by a decision-making network based on deep reinforcement learning (DRL). The relationship of the relative distance between spacecraft and small celestial body, the phase angle, and the images quality are established to calculate the reward at each alternative imaging point. The reward is used as input to guide the training of the autonomous decision-making network. Considering the finite storage volume onboard, the upper limit of the image number is restricted by means of pre-defined constraint and penalty term. Performances of these two means are discussed in the training and validation section of the network. The simulation results show that the proposed autonomous decision-making network could converge in various flyby mission scenarios with good performance. In addition, the well-trained network has short response time, which enables it to operate in a real-time mode.