23rd IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (A5)
Virtual Presentations - 23rd IAA SYMPOSIUM ON HUMAN EXPLORATION OF THE SOLAR SYSTEM (VP)

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UNSUPERVISED LEARNING FOR OBSTACLE AVOIDANCE AND VISUAL NAVIGATION OF MARS ROVER FROM VIDEO

Abstract

The combination of artificial intelligence and deep space exploration has become a significantly important topic for current development. Since the lack of the labelled data, conventional algorithms with supervision cannot be applied to deep space exploration. For obstacle avoidance and visual navigation of Mars rover, this paper presents a novel unsupervised learning framework, including Depthnet module, Posenet module and Kalman filter module, to estimate camera pose and recovery depth map from unlabeled video. Here, the Depthnet uses single-view image as input and outputs the depth maps, and image sequence is utilized to Posenet for estimating camera pose. Although all modules are coupled by geometric constraint for training, these modules can be tested independently. Compared with the existing framework, the framework designs a KF module based on measurement noise estimated from networks without supervision for reducing the noises of pose parameters, and optimizes the Depthnet architecture to add a new upconvolution module and a decoder structure for overcoming the gradient locality and adjusting the mode of multi-task coupling. Our framework integrates all modules to form a cycle optimization strategy. Experimental results show that the cycle optimization framework can effectively achieve single-view depth prediction for obstacle avoidance and camera pose estimation for visual navigation.