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SPACE EXPLORATION SYMPOSIUM (A3)
Mars Exploration – Part 2 (3B)

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IKOSE-BASED HAZARD DETECTION FOR MARS LANDING MISSION

Abstract

Future Mars landing mission is to land probe on the area with high abundant hazards, where are generally recognized that have more scientific information. Hazard detection and avoidance are one of the vital technologies for future Mars exploration. Lidar-based hazard detection fitted a plane to the terrain of Mars, subtracted from original elevation data acquired by scanning lidar. Then the roughness map of surface can be generated. Rough parts stand for hazards such as rocks, craters, and incidence angles represent slopes. The strategy of hazard detection is to search the minimal roughness area, as well as the minimal incidence angle, as the safe landing area. Hence, the key issue is how to accurately fit the terrain plane free of the hazards during landing phrase.Typical robust plane estimation method, least median square (LMedsq), will break down up to 50% of hazards (denoted as outliers). Iterative Kth Ordered Scale Estimator (IKOSE) method was proposed in 2012. It iterated the inner scale estimators to determine the range of outliers, and kept high robust against outliers beyond 50%. In this paper, we combined IKOSE with the least squares (LSq) method to fit robust plane and improved the cost functions by setting different weight values to both outliers and inliers, the weight of each portion is based on the percentage of initial points data. The median of residuals for per iteration is set to be original residual value. Finally, we compare roughness maps generated by proposed method and LMedsq, and evaluate robust and real-time of the two methods on both numerical simulation and experimental test. Preliminary results show that both methods are competent and effective in hazard detection of landing phrase, roughness map using proposed method can detect more hazards information than LMedsq and is more qualified dealing with cases that outliers beyond 50%; in real-time, IKOSE is 12% faster than LMedsq for the case with 100*100 elevation points data, 70 percentage of hazards, 0.9 desired safe landing probability, and zero mean value, 2 deviation of Gaussian noise.