



# FACULTY OF CIVIL ENGINEERING AND GEODETIC SCIENCE

LEIBNIZ UNIVERSITY HANNOVER

Master's Thesis in Navigation and Field Robotics

## Pose Estimation by Detection and Tracking of Artificial Markers for Planetary Exploration

## Posenschätzung durch Detektion und Verfolgung von künstlichen Markern für die planetare Erkundung

Author: Patrick Krömer  
Supervisors (LUH): apl. Prof. Dr. techn. Franz Rottensteiner  
M.Sc. Philipp Trusheim  
Supervisors (DLR): M.Sc. Jongseok Lee  
Dr. rer. nat. Wolfgang Stürzl  
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## Abstract

This thesis presents a new approach of indirectly tracking an static AprilTag with a monocular camera. The method developed, yields a metric pose estimation of the marker even when it leaves the cameras field of view. This was accomplished by using a keyframe-based direct odometry that was enriched by a spherical motion stereo algorithm in order to perform a 3D-to-2D tracking. The proper scaling of the transformation is achieved by a fusion of the depth maps from the marker and the motion stereo. Furthermore an error model was developed, which yields an uncertainty estimation for every pose, to allow the merging of pose estimations from other sources.

The work was done with consideration of an application to support a landing approach of a micro aerial vehicle in a real scenario. The results that were obtained during this work are promising to further develop this approach.

**Keywords:** Pose Estimation, Artificial Marker, Direct Sparse Odometry, Tracking, Spherical Motion Stereo