IAF SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (2)

Author: Dr. Mark Post
University of Strathclyde, United Kingdom, mark.post@strath.ac.uk

Dr. Romain Michalec
University of Strathclyde, United Kingdom, romain.michalec@strath.ac.uk
Dr. Alessandro Bianco
University of Strathclyde, United Kingdom, alessandro.bianco@strath.ac.uk
Prof. Xiu-Tian Yan
University of Strathclyde, United Kingdom, x.yan@strath.ac.uk
Mr. Andrea De Maio
LAAS-CNRS, France, andrea.de-maio@laas.fr
Mr. Quentin Labourey
LAAS-CNRS, France, quentin.labourey@laas.fr
Mr. Simon Lacroix
CNRS, France, simon.lacroix@laas.fr
Dr. Jeremi Gancet
Space Applications Services NV/SA, Belgium, jeremi.gancet@spaceapplications.com
Mr. Shashank Govindaraj
Space Applications Services N.V./S.A, Belgium, shashank.govindaraj@spaceapplications.com
Mr. Xavier Martinez-Gonzalez
Space Applications Services N.V./S.A, Belgium, xavier.martinez-gonzalez@spaceapplications.com
Mr. Iyas Dalati
Space Applications Services N.V./S.A, Belgium, ida@spaceapplications.com
Mr. Raúl Domínguez
DFKI Robotics Innovation Center Bremen, Germany, Raul.Dominguez@dfki.de
Mr. Bilal Wehbe
DFKI Robotics Innovation Center Bremen, Germany, Bilal.Wehbe@dfki.de
Mr. Alexander Fabisch
DFKI Robotics Innovation Center Bremen, Germany, Alexander.Fabisch@dfki.de
Dr. Fabrice Souvannavong
Magellium, France, fabrice.souvannavong@magellium.fr
Mr. Vincent Bissonnette
Magellium, France, vincent.bissonnette@magellium.fr
Dr. Michal Smisek
DLR (German Aerospace Center), Germany, michal.smisek@dlr.de
Dr. Nassir W. Oumer
DLR (German Aerospace Center), Germany, Nassir.Oumer@dlr.de
Mr. Lukas Meyer
DLR (German Aerospace Center), Germany, Lukas.Meyer@dlr.de
Dr. Rudolph Triebel
DLR (German Aerospace Center), Germany, rudolph.triebel@dlr.de
Dr. Zoltán-Csaba Márton

DLR (German Aerospace Center), Germany, Zoltan.Marton@dlr.de

INFUSE DATA FUSION METHODOLOGY FOR SPACE ROBOTICS, AWARENESS AND MACHINE LEARNING

Abstract

Autonomous space vehicles such as orbital servicing satellites and planetary exploration rovers must be comprehensively aware of their environment in order to make appropriate decisions. Multi-sensor data fusion plays a vital role in providing these autonomous systems with sensory information of different types, from different locations, and at different times. The InFuse project, Funded by the European Commission's Horizon 2020- Strategic Research Cluster in Space Robotics, provides the space community with an open-source framework by which data may be fused in a modular fashion from multiple sensors. In this paper, we summarize the modular structure of InFuse and show how it is used for an example of planetary rover sensing in a complex ground environment. Multiple sensor data from field testing that includes inertial measurements, stereo vision, and scanning laser range information is first used to produce robust multi-layered environmental maps for path planning. This information is registered and fused within the InFuse framework to produce comprehensive three-dimensional maps of the environment. To further explore the potential of InFuse from a more research-oriented perspective, we additionally evaluate the use of machine learning algorithms to take multi-sensor fused data from InFuse and classify structured parts of the environment that may be of interest to the planetary rover. We consider the use of deep learning methods, probabilistic methods or other machine learning methods to perform classification of parts of the environment with various features such as flat areas, rocky areas, and areas that may be of scientific interest. Additionally, the definition of data quality assessment methods, such as visual feature matchability, will enable a continuous evaluation of the algorithms. These shall drive the search for an optimal configuration of the InFuse components so to maximize performances in relation with the context into which they operate. Making use of the modular nature of InFuse, we will show that different results may be obtained from the identification process depending on the sensors and sensor fusion methods applied, as well as the type of object, and consider the effects of limited computing power and computational time on the data fusion process in selection of the machine learning methodology.