# Short Term Mobility Program 2016

# Final Report

***Beneficiary:*** Dr. ANNALISA MILELLA, Researcher, Institute of Intelligent Systems for Automation (ISSIA-CNR), Bari, Italy
***Host Institution:*** Danish Technological Institute, Centre for Robot Technology, Odense, Denmark
***Period of stay:*** September 29th – October 20th 2016

***Title of the research program:***
Multi-sensor cooperative perception of robotic vehicles for precision farming

***Description of the research activity:***
Precision farming relies on the ability to accurately measure the soil properties, in order to apply a local remedy without wasting resources or contaminating the environment.
The research activity carried out in the context of the Short Mobility Program 2016 at the Danish Technological Institute, Centre for Robot Technology, Odense, Denmark was aimed to study and develop methods to integrate different sensor data to create multi-modal terrain maps to be used by an autonomous vehicle to carry out precision farming operations. In particular, the fusion of optical (stereovision), thermal, and hyperspectral information has been investigated to generate detailed terrain maps, both to increase precision during applications and to provide fast automated safety responses.
The activity included the following main phases:
1. *Data gathering*:
First of all, data were acquired on different terrain types such as concrete, asphalt, agricultural terrain and gravel, using a multi-sensor system. The latter included a stereo camera, a hyperspectral camera and a thermal camera.
2. *Data processing*:
First, issues related to the integration of the different sensor modalities were analysed. In particular, the problem of sensor calibration to estimate the relative

position of the different sensors with respect to each other was specifically addressed. A stereo-based mapping approach to produce a 3D terrain map was then developed. The development of a method to fuse the different sensor modalities into the 3D map for the purpose of terrain characterization was also initiated, and is part of current collaboration. The idea is that of registering hyperspectral and thermal data with respect to stereo data to augment the stereo-based map with spectral signatures to identify the nature of the observed surfaces. Such maps will be successively processed by using supervised or unsupervised classification methods to generate semantic representation of the environment and specifically of the supporting terrain.

***Conclusions***

It is expected that the results of the research will lead to at least one scientific publication. Future developments of the proposed models and methods will be aimed at reaching improved environment perception and navigation capabilities of agricultural and field robots. Furthermore, the research program will lead to collaboration opportunities between DTI and CNR ISSIA, including the submission of research proposals under international research frameworks such as the upcoming Horizon 2020 calls.

Bari, 25/10/2016

Dr. ANNALISA MILELLA