ADACORSA

Making drones safe and efficient vehicles for observation, analysis, and transport in BVLOS operations

Drones need to operate safely in variable, dynamic and unknown environments. New technological possibilities and maturity levels support increasingly complex drone applications to meet future regulatory requirements. To exploit the potential of drones commercially, the ability to fly without a direct line of sight (Beyond Visual Line of Sight, BVLOS) is important. To minimize risks of autonomously flying systems, BVLOS operations require the drone to detect and perceive the environment.

The ADACORSA project aims to strengthen the European drone industry and increase public and regulatory acceptance of BVLOS drones. To achieve this vision, technologies are demonstrated for safe and reliable drone operation in all situations and phases of flight. This involves the transfer and extension of automotive sensor and control technologies, as well as commercial off-the-shelf communication technologies. Innovative safety features are applied to achieve an appropriate level of safety for modern unmanned aviation.

The activities within the project were divided into ten supply chains. These included component level, system level, architecture level to demonstrator level. Virtual Vehicle Research GmbH was the lead of Supply Chain 3 "Reliable and fail-operational environment perception" and focused on the development of stereo matching algorithms suitable for estimating the depth in scenes featuring slanted surfaces.

A combined approach was used to compare the left and right images of a stereo camera and estimate the depth of objects based on the disparity of the images. The novel inference approach is based on continuous (rather than discrete) message passing. In a first step, it was used to obtain subpixel accurate disparity estimates. Unlike most existing stereo algorithms, the models were extended to include higher order priors which capture the distribution of natural images more accurately with no staircasing effect and more accurate curve fitting.

In a second step the inference approach was combined with an MRF-based learning framework leading to spatially weighted context-aware priors. To train the network, thousands of virtual images from different environments were collected in Microsoft AirSim.

The results of this combined approach have been validated on various datasets with available ground truth data. It could be shown that the results generalize to data with different type of scenes, like traffic (KITTI dataset) or indoor scenes (Middlebury stereo dataset). The final activity was the demonstration of the depth estimation approach with real-world data. A test flight was conducted with a ZED2 stereo camera that recorded the data as two sequences of left and right rectified images. The image set was integrated into the developed data loader and successfully loaded into the simulation environment. The algorithm was evaluated on all frames in both sequences. The calibration data from the drone was used to convert the estimated disparity into depth.