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ITIS

Flight Control & Autonomous Out-/Indoor UAV

Mehmetaj, S.(1) , Janugade S .(1) , University of Applied Sciences Karlsruhe

(1) Scientific assistant at HS Karlsruhe (HSKA), Laboratory for GNSS & Navigation

Project Overview

The navigation of autonomous vehicles in out- and indoor areas is the goal of a research cooperation with Daimler, Sindelfingen, specifically for UAVs in indoor scenarios, eg in factory buildings. Based on image markers and visual odometry (VO) from continuous stereomatching of the environment, in addition to accelerometer, gyroscope, and MEMS barometer, the navigation is indoors supported by ITRF-consistent position information or with speed and rotation rate observations from VO. Outdoors navigation information like position and velocity is provided by GNSS.
The project consist of :

- Hardware designs and development of the Navka flight controller boards (*NAVKArine FC-4 board followed at present by NAVKArine FC-6 board*).
- Algorithms / Software / Firmware development for the Flight controller (FC).
- Software development of Ground Control Station (NAVKAGCS).
- Live Video Streaming from the UAV

Flight Control *NAVKArine FC-4*

The Navka system (algorithms, software and hardware) can be used for the navigation and control of multicopters like Unmanned Aerial Vehicles (UAV) and systems (UAS) respectively or manned multicopters as well as Robotik Applikations. Hereby the multicopters can be designed scalable in respect to:

- Applications
- Size
- Payloads
- Sensor equipments
- UAS

The flight navigation and control system is based on redundant GNSS, MEMS, camera and MOEMS sensors (see Fig. 1). In the indoor area, MEMS and the stereo camera optics are the main component for positioning and orientation via visual odometry (VO) as well as georeferenced markers.
Features of the Navka Flight Control :

- Developed from the scratch at HSKA, Laboratory for GNSS & Navigation.
- Up to 1000 Hz control loops.
- Multisensor NAVKA data fusion algorithms.
- Supports Remote Control RC via Spektrum DX8 (see fig. 1)
- Supports Control Unit / Client via NAVKA Ground Control Station (NAVKAGCS Fig.2)

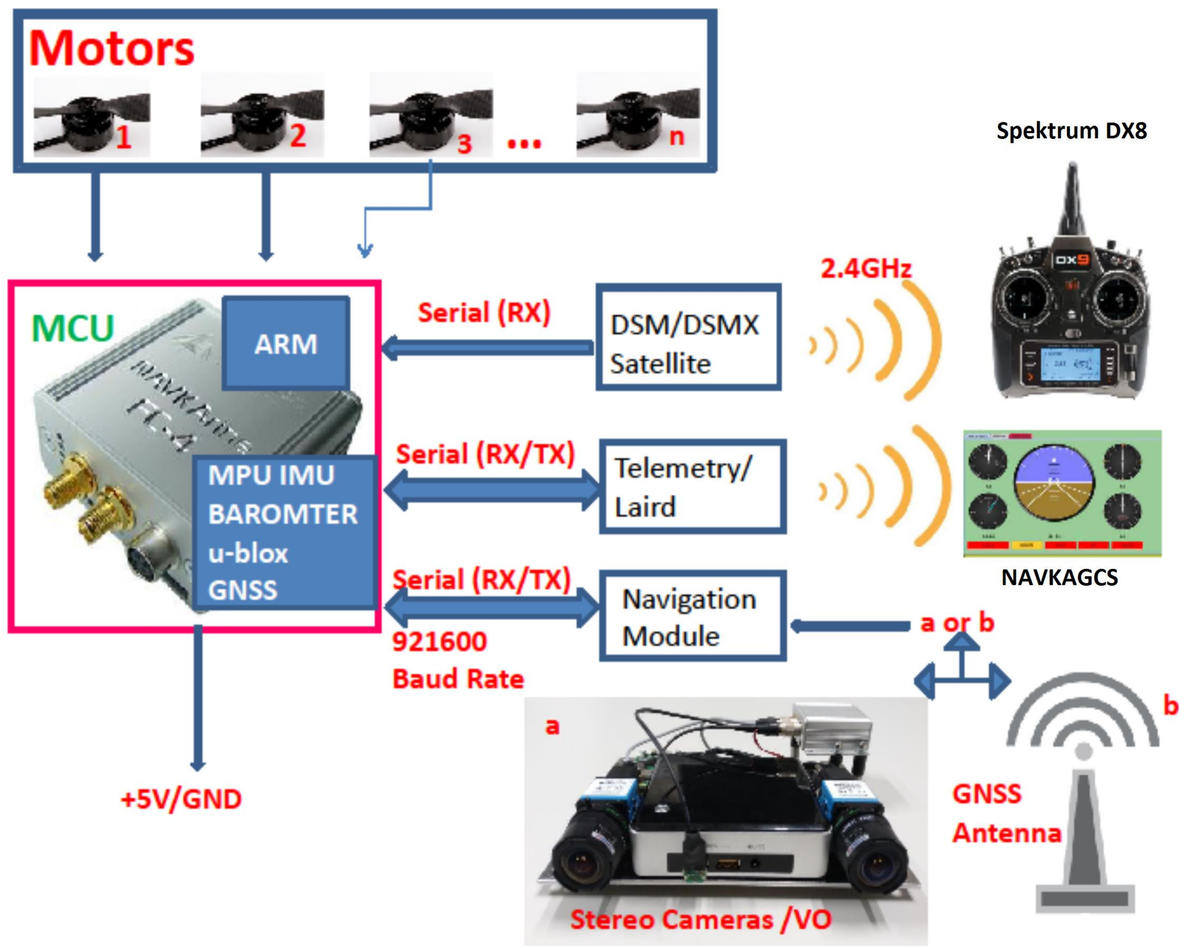

Fig 1. Block Diagram of the NAVKA UAV / UAS Systems

NAVKA Ground Control Station (NAVKAGCS)

NAVKA Ground Control Station is an operator control unit ground control software for unmanned aircraft (fig. 2). It allows to visualize and control an unmanned aircraft during development and operation, both indoors and outdoors. The purpose of the NavkaGCS is real-time monitoring of an UAV.

Features of the NAVKAGCS:

- Multi-system/ platform support (multiple protocols, multi rotary like quadcopters, hexacopters)
- Serial & UDP connection to the UAV.
- Bidirectional Communication between NAVKA-Ground Control and FC via wireless telemetry.
- Mavlink protocol or Navka protocol for the communication.
- Display of real-time data of the UAV / UAS performance and position and serve as a “virtual cockpit”
- Console window for important messages (ASCII or Mavlink-messages)
- Live Video Downstreaming (on a 2nd monitor)
- 3D Model of the building where the aircraft flies.
- Mission planning by sending a multiple waypoint and further navigation state vector commands, respectively.
- Configurable flight mode (Autonomus or Manual).
- Sends Commands to the drone like:
  - ❖ Arm Motors
  - ❖ Take Off
  - ❖ Go to Position X (Waypoint x,y,z)
  - ❖ Position Hold
  - ❖ Return Home
  - ❖ Land
  - ❖ Disarm

Fig. 2: NAVKA Ground Control

Fig. 3: NAVKA FC4 Flight Control Board

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NAVKA

Kontakt
Center of Applied Research (CAR)
University of Applied Sciences Karlsruhe
Prof. Dr.-Ing Reiner Jäger
Tel ++49 721 925 2592
Mail reiner.jaeger@hs-karlsruhe.de
URL www.navka.de