UAV-SzTAKI – The current state

Progress:

The Plane No. 1 is ready to fly. One flight has already been performed with the purpose of testing the plane setup, the correct operation of the actuators, and the manual controllability.

A test flight is prepared for the next week with the purpose to test the data acquisition capabilities, and to collect data belonging to the basic flight operations. The collected data will be suitable for initial identification purposes.

The hardware setup of the Plane 1 is unchanged; the on-board program has been slightly modified:

1. An error in the checksum generation has been corrected.
2. The data acquisition has been extended, the accelerations, the magnetometer data, and the GPS altitude is also included in the data packet transferred to the ground station.
3. Measuring the battery voltages and generating an alarm signal in the case of excessive discharging can optionally be included in the code.

We have got skills and experience in modifying, compiling and uploading eCos-style programs in the MPC555 environment. The new program versions are written in parallel to the microcomputer flash without overwriting the original program.

We developed and use new Ground Station software written in WindowsXP that can display and save the acquired data. This software is not open-source, however the executable program is freely distributable. We use it for our convenience; we can easily modify it according to the requirements of the data acquisition.

Plane No. 2 is almost ready. A Phytec MPC555 module and an xBow MNAV-100 has been purchased and given at our disposal by the Budapest Technical University. All necessary component are available except the RC multiplexer RxMux. We could not find a local dealer for this product, we must find other sources of supply. After all the components are in our disposal, some hours of work is needed to complete the plane.

Problems:

The European version of the data modems, i.e. XStream 2.4 GHz, produces considerably lower range than the US versions operating in the 900 MHz band. By using 0 dBi antennas, that are supplied by MaxStrem (Digi) approximately 200 m is given. We try to use antennas with higher gain, e.g. outdoor omnidirectional WiFi 2.4 GHz antenna on the Ground Station and a helical antenna on-board.

UAV-SzTAKI – Plans for the next period

I. HW design

1. MPC555 daughterboard design
    - 2-layer PCB
    - Well-designed grounding system for optimal EMC and noise characteristics
    - Extended functionality:
        - One RS232 transceiver with enable/disable functionality
        - Measuring 2 battery voltages for safety purposes
        - Spare digital I/O lines for control purposes
        - RSSI (Received Signal Strength Indication) for the wireless communication lines
        - Watchdog output signal for safety purposes
2. Fail-safe board design

    Goals: ensuring well-defined functionality in the cases when the wireless links or the board-computer is lost

    Solution: designing a fail-safe board on 8-bit microcontroller basis. Requirements:

    - Simple program structure, assembly level programming.
    - Adequate switching of actuator control sources.
    - Fail-safe actuator control for the cases of loss of
        - manual wireless control (realized by the hobby RC transmitter/receiver),
        - digital communication line (network),
        - functionality of the board computer,
        - dominant charge of main battery,

      in any combination.

    The fail-safe board extends the functionality of the RxMux board.
3. Designing an on-board wiring scheme that results in better EMC and noise immunity.

II. System level design:

1. Applying network (point-to-multipoint or mesh topology) instead of point-to-point connection in the digital communication.
2. Designing a bi-directional secure fail-safe communication among the agents.

III. Identification and control design

1. System identification based upon measurements performed during manually controlled test-flights with the purposes to produce accurate control-oriented models of the planes.
2. Designing controls schemes for the different flight tasks and scenarios.
3. Tests and identification of the closed-loop system, iterative control design.

IV. Performing test-flights

Performing test-flight with data acquisition and evaluation of data with the purpose of testing the control solutions developed as well as verifying the results belonging to all the partners.