Automated Flight Time Measurement for F5J

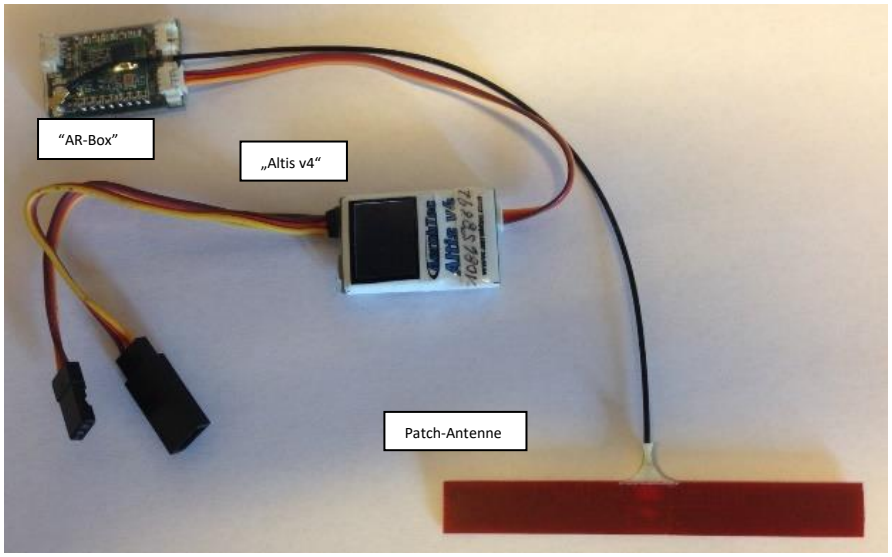
Foreword

The development of the "automatic time measuring system" takes place in cooperation with AerobTec. The company AerobTec is responsible for the development of the appropriate hard- and software; the necessary consultation and the execution of the test flights for the determination of the operability were made by me in cooperation with my club mate Holgard Tunker.

Specifications:

The following specifications have been made:

- The "Altis v4" logger remains in its current form and is supplemented by the so-called "AR-Box" (Acccelleration-Radio-box) with acceleration sensor and transceiver. It has a mass of approx. eight grams.
- The "AR-Box" is connected via a three-pole cable to one of the COM interfaces of the "Altis v4". Thus an existing "Altis v4" can be reused with modified software and, if necessary, the "AR-Box" can be located spatially separated in the fuselage.
- The acceleration signals of the x, y and z axes are combined to a sum signal ("SADA signal"), so that the "AR-Box" can be accommodated in the fuselage in any orientation; this facilitates easy handling and avoids unnecessary errors.



Picture 1, Shows the LayOut of the system and its components

In advance, an attempt was made to detect the release of the model by means of the acceleration signal; however, this is not always possible since the "SADA signal" can be superimposed by the motor and/or gear noise, depending on the drive used.
For this reason, it was decided to use the clearest signal, i.e. motor start, as the start signal.

Intensive preliminary tests during competitions have shown that typically less than one second elapses between switching on the engine and releasing the model.
If it is also assumed that the pilot wants to make full use of the motor run time of 30 seconds, then it is also

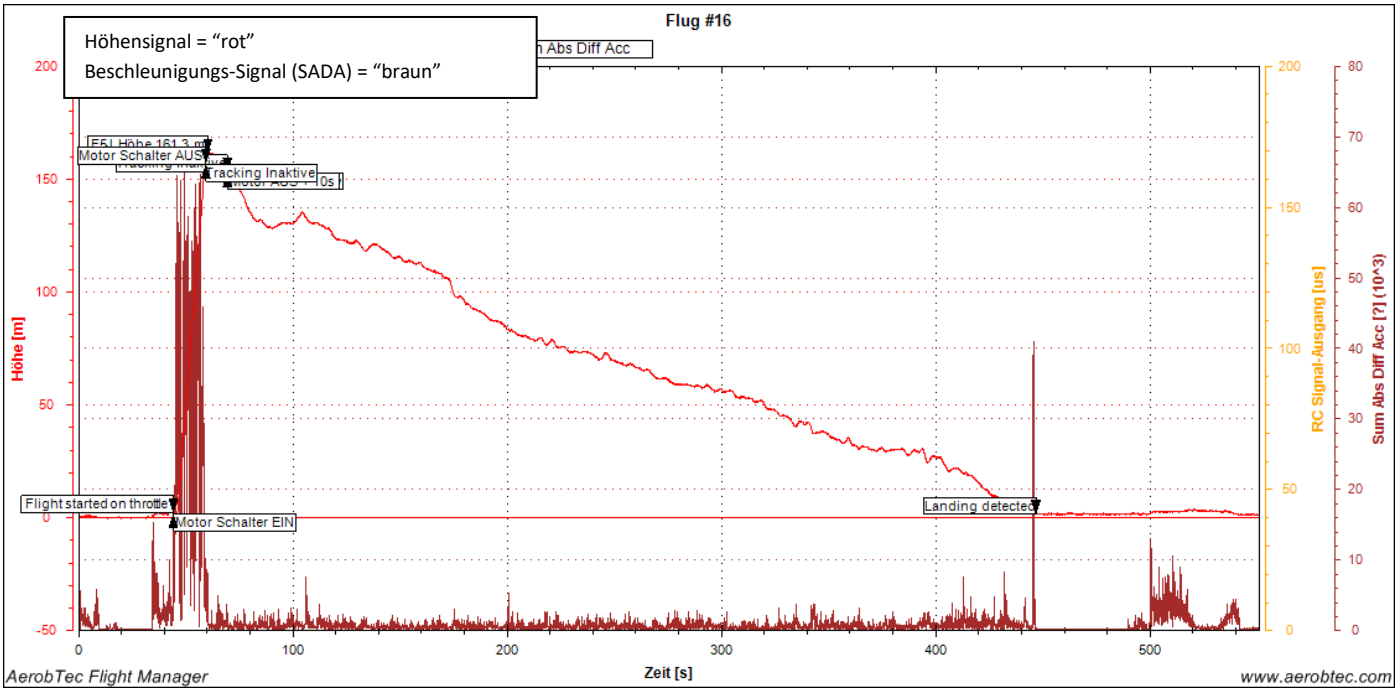
possible with a clear conscience to define switching on the motor as a "start" signal for measuring the flight time

During landing, clearly detectable is not the first ground contact but the moment the model comes to rest. If the model has come to rest and is lying on the ground, the "SADA signal" is zero from this point on. If twenty zero signals occur without interruption after the model comes to a rest (this means a period of two seconds at a clock rate of 10 Hz), this is defined as "final standstill". The actual standstill relevant for the timing is then 20 x 0.1 = 2 seconds earlier, i.e. two seconds are subtracted automatically by the system from the time of the "final standstill".

Measurements

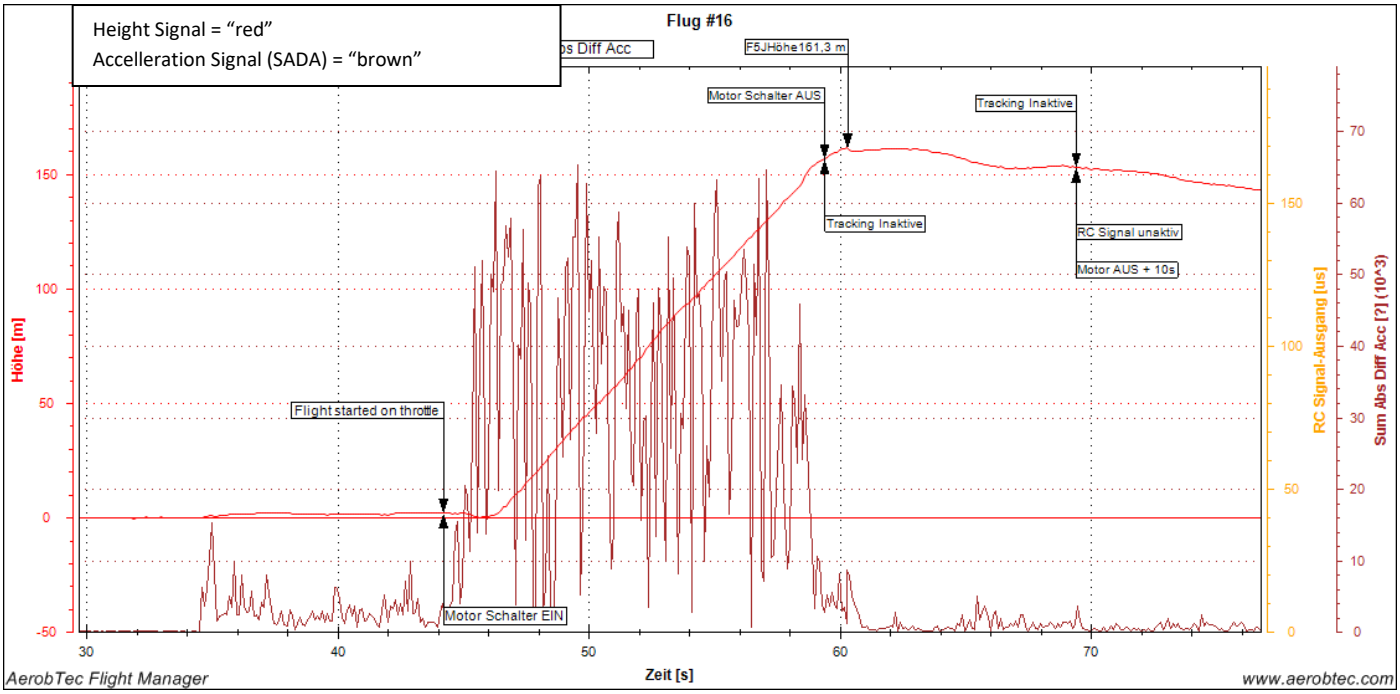
In the following, a test flight prepared with the "AerobTec Flight Manager" is shown in its relevant flight phases:

Complete Flight:



Picture 2, Shows the entire flight. The "SADA signals" are always sufficiently high during the flight; Only sporadic zero-signals occur which are not interpreted as a landing. (see also picture 3 und picture 4)

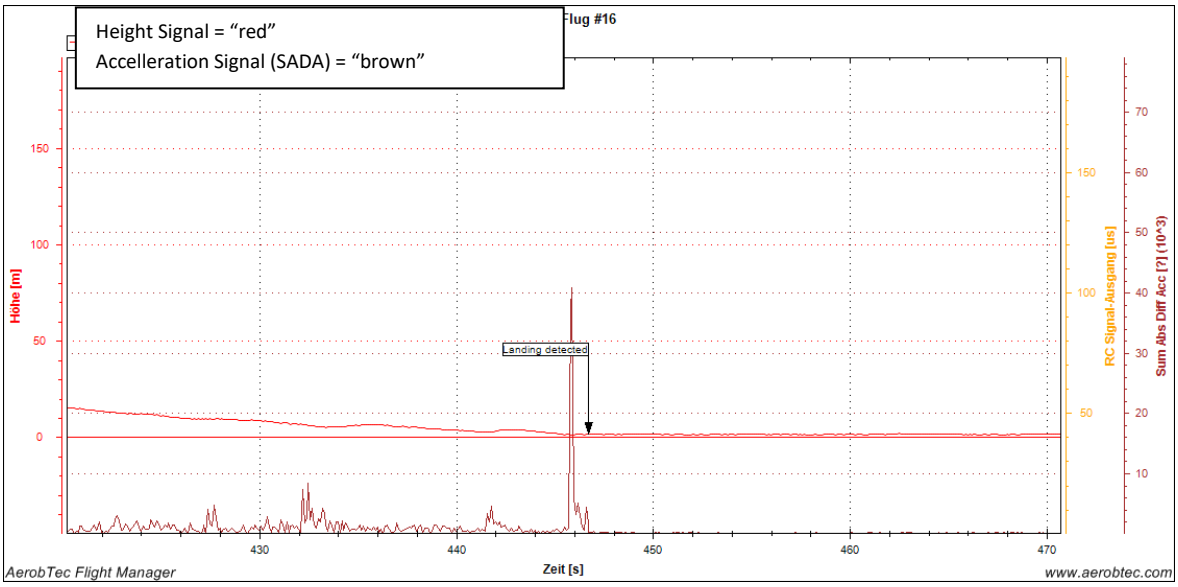
Startphase:



Picture 3, It shows the following chronological sequence: Up to 32.5 seconds the model lies on the ground, then it is lifted and carried to the starting point. ***At 44 seconds the motor is switched on ("motor switch ON") and the F5J flight time begins****. At 59 seconds the motor is switched off and at 60.5 seconds the F5Jaltitude is recorded at 161.3 meters*

The "SADA signal" during engine operation differs significantly from the other signal characteristics in terms of amplitude and signal shape, even if the engine is only operated at low power. If it should happen that a pilot is suspected to have switched on his motor without permission during gliding, this can be clearly clarified by reading the recordings.

Landing :



Picture 4, It shows the following data: During the landing approach there are always small "SADA signals" by the correction of the orbital curve; when touching down there is an acceleration peak (the amplitude of which depends strongly on the "quality" of the landing). ***The standstill of the model ("landing detected") is the end of the flight time*** *and is recorded to the nearest tenth of a second.*

Taking into account the working time:
The problem of an early start and a late landing is solved by the fact that the logger is equipped with a transceiver, which receives the frame time sent from the competition management, compares it with the take-off and landing time, registers possible collisions and displays them on the logger display.

Lab-Tests:

- Working time „wt“ =62,2 sec
- F5J Height F=33,2 m (“F” will be changed to “H“(height)
- Flugzeit „ft“=18.1 sec
- "Sr" is the time between the beginning of the "wt" and engine start; "Sr"=+28.5s means that the start followed 28.5s after the beginning of the working time; at an early start "Sr" would be followed by a minus sign and would flash
- „Lr" is the time between the landing (standstill of the model) and the end of the working time; "Lr"=15,7s means that the landing took place 15,7s before the end of the "wt"; if the landingwould have been too late, "Lr" would be marked with a minus sign and would flash**.**

Picture 5, Results from Lab-Tests

Final scope of services:
At the end of the working time, the relevant results: wt, F (H), ft, Sr and Lr are transmitted directly via radio to the ground station ("base station") for evaluation; the results are assigned to the serial numbers of the individual loggers.
These serial numbers are assigned to the models A, B and C and communicated to the organizer at the registration for the competition.
When the starting order is drawn, the serial numbers are assigned to the starting numbers.
If a competitor has only one logger for all models, it is not possible to determine which model will be used; however, this is only secondary.
All relevant results for each participant of a group are also displayed on the screen of the evaluation computer.

Height correction:
Since no official helpers are required for timekeeping, the required manual control of switching on the model lying on the ground can no longer be carried out. For this reason, a "zero adjustment" is carried out automatically at the time the motor is switched on.
For this purpose, the altitude signal is glidingly averaged over twenty supporting points and taken as "zero point" when the motor is switched on; with this method, zero point drift due to changes in air pressure during a longer waiting period is omitted. Assuming a height difference of 0.5 m when releasing the models, the inaccuracy for this case is 0.25 m.

Necessary rule changes:
For the reasons mentioned above, the flight time does not have to start when the model is released but when the motor is switched on and no longer ends when the model touches the ground for the first time but when it comes to a standstill. In contrast to a model standstill, a contact with the ground or an object cannot be evaluated in a reproducible manner. This change also makes sense, since the distance from the center of the landing circle can only be determined after the model has come to a complete rest.
The necessary Rule Changes will be submitted for the next ciam-meeting as a proposal of the DAeC.

Conclusion:
After successful field testing of the time measurement, small test competitions can be started with radio transmission of the frame time and transmission of the measured values to the competition management in order to check the stability of the arrangement.
Even if no "base station" is in operation, logger shows the altitude and flight time on the display for the timekeepers and the pilots to read it and use it for competition or training.

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R. Decker