Unmanned aerial vehicles (UAVs) or drones are used increasingly for missions where piloted aircraft are unsuitable. The unmanned aircraft has a number of advantages with respect to size, weight and manoeuvrability that makes it possible for them to solve tasks that an aircraft previously has been unable to solve. The primary cause that UAVs has reached the current level of development is their military potential. Both for surveillance operations and direct strikes, UAVs has many benefits compared to manned aircraft, and the biggest of those are that no pilots are put in direct contact with enemy troops. Gradually UAV’s are also being introduced in civilian applications. In this setting they have reduced the difficulty of tasks such as photo inspections of large buildings and rescue missions at sea. All in all UAVs have shown their great potential within the recent years. The increasing use of UAVs causes them to coexist with manned aircraft and in areas where humans are present on ground. This of course carries demands to the safety and reliability of the aircraft. It is inevitable that components onboard a UAV will fail at some point in time. When this happens it is important that the fault is discovered in time such that appropriate actions can be taken. That could either be the aircraft controlling computer taking the fault into account or a human operator that intervenes. Detection of faults that occur during flight is exactly the subject of this thesis. Safety towards faults for manned aircraft is often achieved by making most of the systems onboard redundant. This is an easy way to obtain safety since no single system fault is catastrophic. The failed subsystem can be disconnected and the redundant systems can take over the tasks of the failed system. For smaller UAVs both price and weight of the aircraft is very important meaning that redundant hardware will not be an applicable safety solution. This is why focus of this thesis have been on methods where redundancies are obtained by models and knowledge about the aircraft behaviour. Based on telemetry data from a specific UAV, used by the Danish military, it is investigated how a number of critical faults can be detected and handled. One of the challenges using telemetry data for the fault diagnosis is the limited bandwidth in the radio link between the aircraft and the base-station on ground. This combined with noise on the signals makes it difficult to use precise models for the fault diagnosis. This is solved by using statistical distributions to describe the aircraft’s normal behaviour and deviations from this, indicating different faults. To increase the applicability of the models, used for fault diagnosis, these are adaptive to some extent. This makes small discrepancies between aircraft and wind conditions to have less influence on the performance of the fault diagnosis with respect to time to detect and false alarms. It also means that less adjustment is needed if the methods should be applied to another type of aircraft with different parameters. Amongst the main findings of this research project is a method to handle faults on the UAV’s pitot tube, which measures the aircraft speed. A set of software redundancies based on GPS velocity information and engine thrust are used to detect abnormal airspeed signals. Another contribution worth mentioning considers diagnosis of control surface faults. Here a set of low-complexity models between the aircraft’s turn rates and input deflections are used in the fault detection. Both methods has been verified against data from incidents where the respective faults occurs, and show good potential. The thesis consists of a summary of the different methods, investigations and results obtained during the project. Detailed descriptions are found in a number of papers submitted to research conferences and journals during the project. These have been enclosed in the last part of the thesis.

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