# LINK-SIC — Aircraft System Identification

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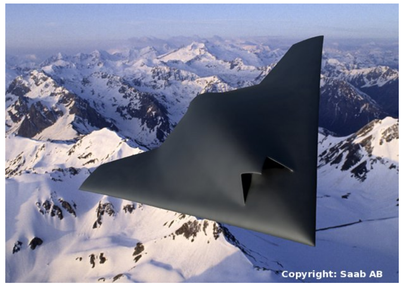
## Background

There are often very high demands on systems in aerospace applications and therefore, it is not surprising that many challenging research problems can be found in this area. Within LINK-SIC, research concerning aerial vehicles will be conducted in several joint projects between Saab AB and Linköping University.

## System Identification

A key component in a manned or unmanned aerial vehicle (UAV) is its control system, which should have a very high reliability and robustness while at the same time guaranteeing a high performance of the resulting closed-loop system. Today, the development of such a control system relies heavily on the availability of accurate models of the vehicle. Aerodynamic forces and torques constitute a crucial part of the properties of any type of aerial vehicle and it is therefore important that these factors are captured by the model. Typically, aerodynamic modeling is quite time-consuming and it is therefore interesting to try to use algorithms and tools from system identification for making parts of it more automatic. This will be investigated within two LINK-SIC projects.




The objective of these projects is not to propose system identification methods as a replacement for more traditional aerospace modeling approaches, but rather to develop such methods further and show that they can be a valuable complement to the traditional approach. In particular, this should be interesting in UAV projects, which typically have tighter economical constraints and time scopes than projects concerning manned aerial vehicles.

## Improved Usage of Flight Test and Computational Data for Aerodynamic Modeling

Several issues concerning system identification and parameter estimation for aerodynamic modeling are investigated in this research project. The main objective is to obtain more accurate initial models and thus to reduce the risk for unexpected behaviors in flight tests. More accurate models might also result in less conservative control laws, i.e., a resulting system with higher performance.


### Open Questions

- Which methods can be used to make the parameter estimation more efficient than today?
- How should the aerodynamic model be designed in order to support the control design?
- How should flight tests be performed in order to give useful and relevant data for the modeling process?
- Which methods can be used to identify unstable, nonlinear, closed-loop systems?
- Which model structures can be used to capture the particular aerodynamic properties that an aerial vehicle exhibits at transsonic velocities or at high angles of attack?
- Which tools for experiment design and online data evaluation can be used to guarantee that a flight test really will provide all data that is needed for the aerodynamic modeling?

## System Identification in Aerospace Applications


In many application areas, helicopters constitute the most suitable type of UAV platform because of their maneuvering flexibility, in particular at takeoff and landing. A helicopter is also an interesting application from a general research perspective since it contains many of the challenges that can be encountered when identifying a dynamical system. The objective of this project is to develop tools and principles for system identification that can be used for a faster and more accurate modeling of aircraft and helicopters based on flight test data.

### Open Questions

- How can model errors in nonlinear state-space models be detected?
- How can gray-box and black-box models be combined in order to get a complete model that is as accurate as possible?
- Which is the optimal way to use the additional measurement signals that are available in some aerospace applications?
- Which types of helicopter flight test data are most suitable for system identification?
- How should test flights with helicopters be designed in order to provide useful information about the system?
- Which approximate helicopter models are most useful for control design and how should they be estimated?