

Universität Stuttgart

# Spezialisierungsfach Flugführung und Systemtechnik

Luft- und Raumfahrttechnik



Institut für Luftfahrtssysteme  
Prof. Daw & Annighöfer

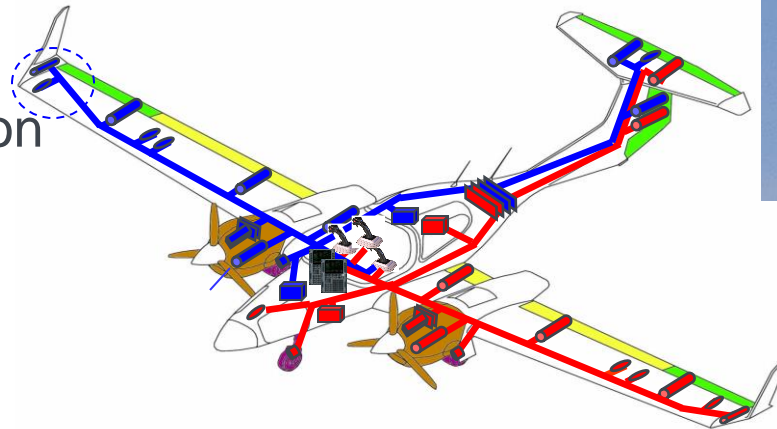
Institut für Flugmechanik und Flugregelung  
Prof. Walter Fichter



# Beteiligte Institute

## Institut für Flugmechanik und Flugregelung (iFR)

- Guidance & Control
- Robotics & Perception
- Systems theory  
& Optimization

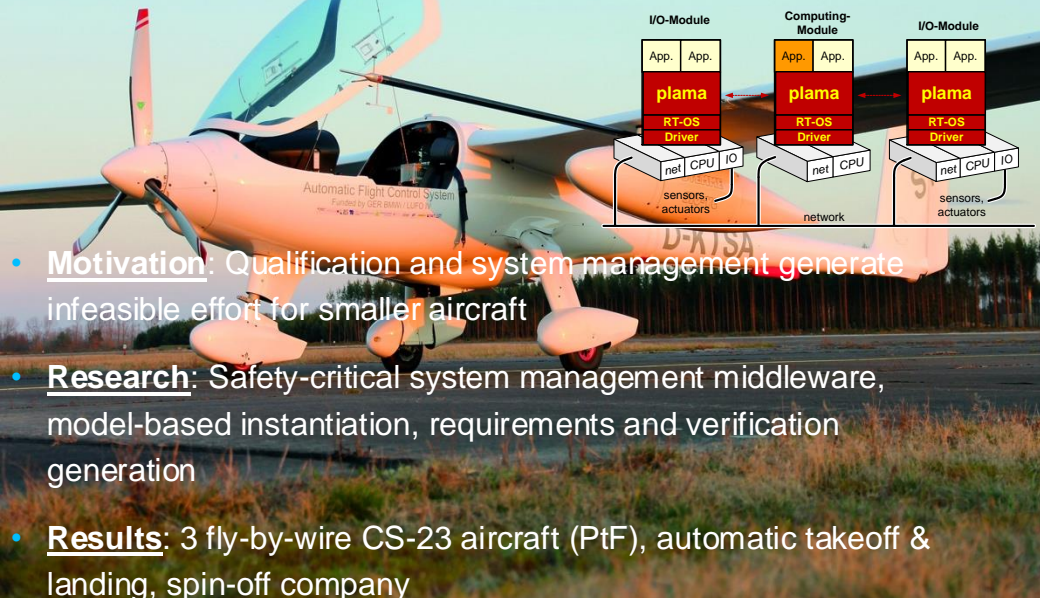


## Institut für Luftfahrtsysteme (ILS)

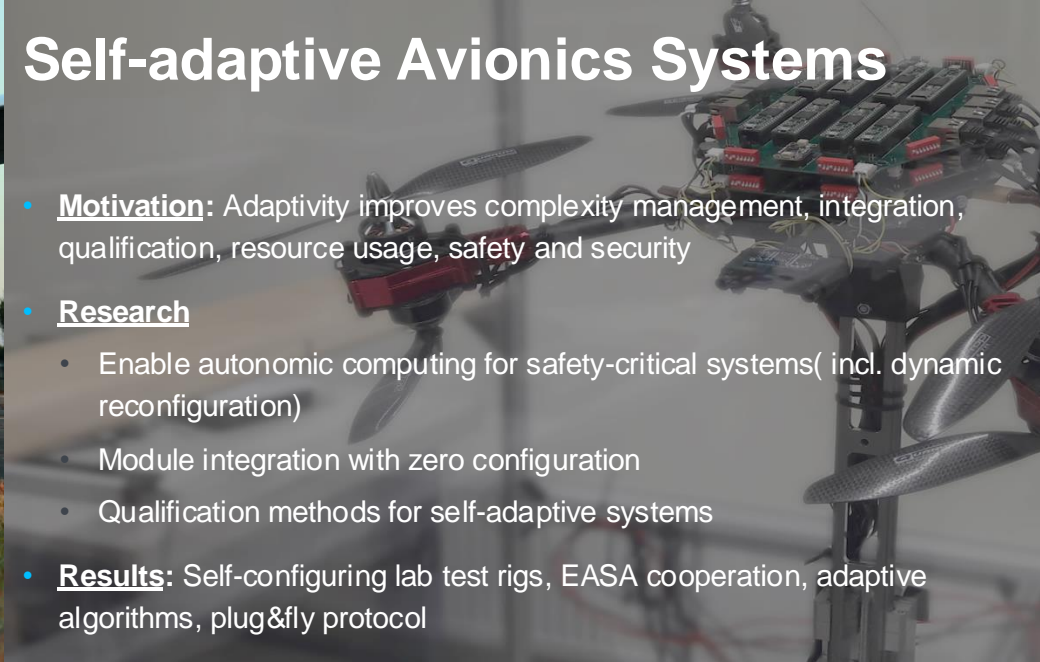
- Gesamtsystem Luftfahrzeug
- komplexe Systeme
- Sicherheit und Zuverlässigkeit



# Flexible Avionics Platform



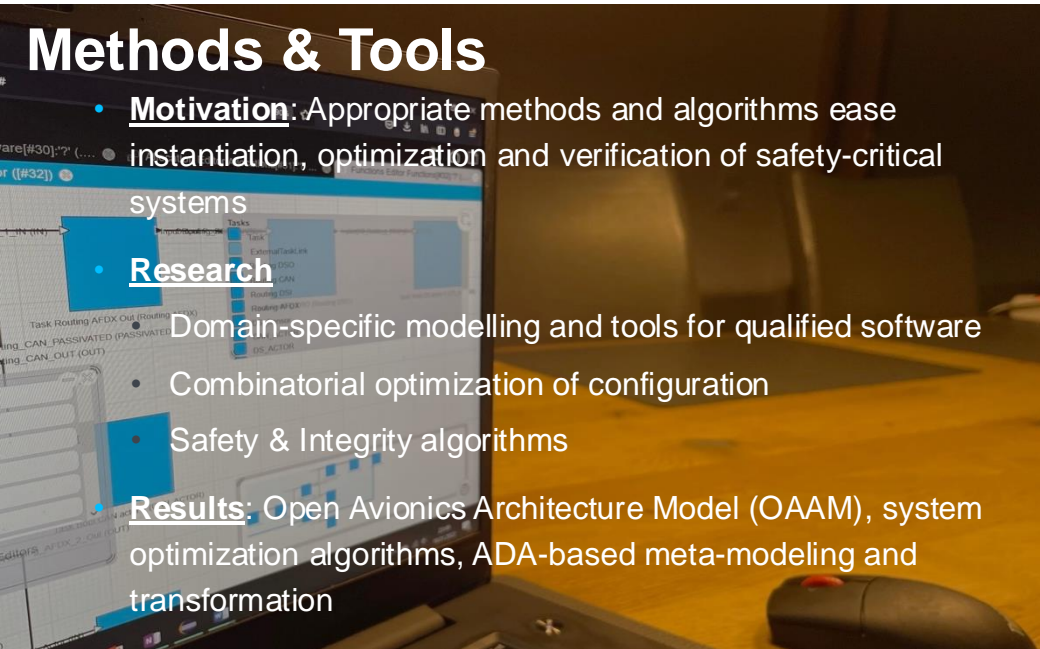
- **Motivation:** Qualification and system management generate infeasible effort for smaller aircraft
- **Research:** Safety-critical system management middleware, model-based instantiation, requirements and verification generation
- **Results:** 3 fly-by-wire CS-23 aircraft (PtF), automatic takeoff & landing, spin-off company



# Self-adaptive Avionics Systems

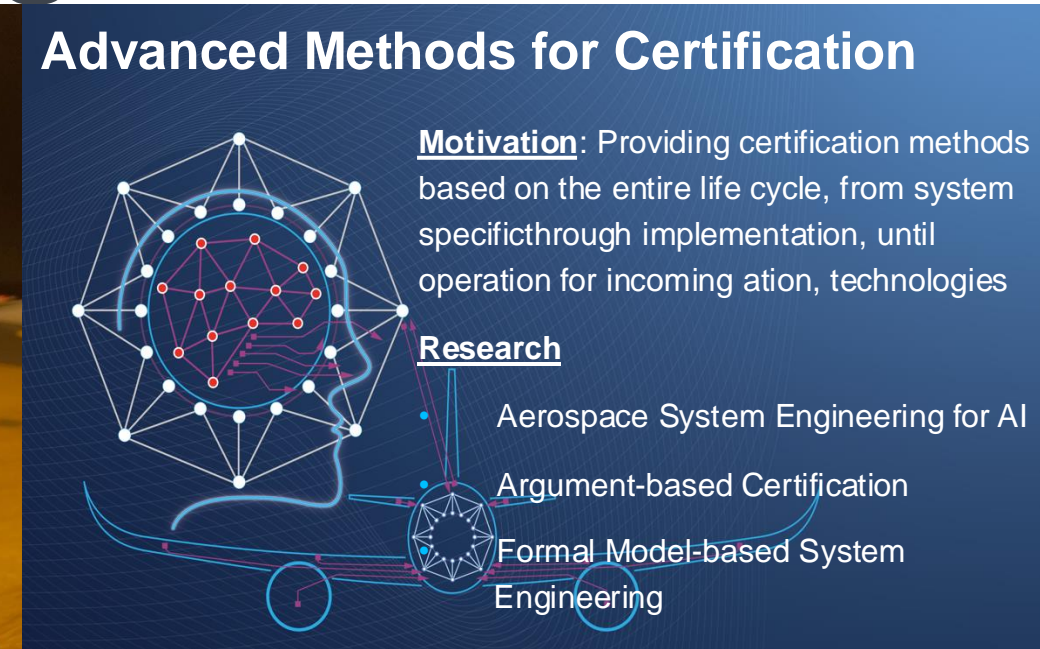
- **Motivation:** Adaptivity improves complexity management, integration, qualification, resource usage, safety and security
- **Research**
  - Enable autonomic computing for safety-critical systems( incl. dynamic reconfiguration)
  - Module integration with zero configuration
  - Qualification methods for self-adaptive systems
- **Results:** Self-configuring lab test rigs, EASA cooperation, adaptive algorithms, plug&fly protocol

# ILS - Forschung und Praxis



## Methods & Tools

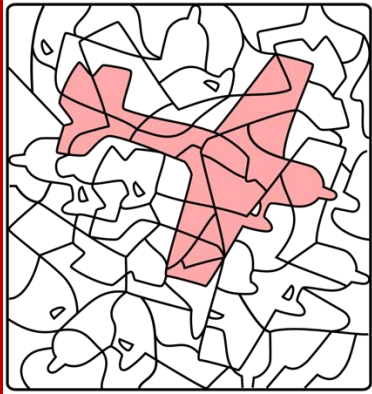
- **Motivation:** Appropriate methods and algorithms ease instantiation, optimization and verification of safety-critical systems
- **Research**
  - Domain-specific modelling and tools for qualified software
  - Combinatorial optimization of configuration
  - Safety & Integrity algorithms
- **Results:** Open Avionics Architecture Model (OAAM), system optimization algorithms, ADA-based meta-modeling and transformation



## Advanced Methods for Certification

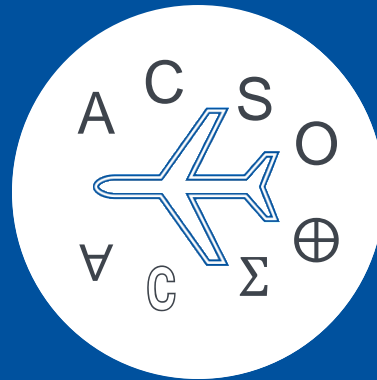
- **Motivation:** Providing certification methods based on the entire life cycle, from system specification through implementation, until operation for incoming technologies
- **Research**
  - Aerospace System Engineering for AI
  - Argument-based Certification
  - Formal Model-based System Engineering

## Guidance & Control Systems



Path planning  
Multivariate control  
AI Methods  
Periodic systems  
Comfort of ride

## Algorithmic Flight Control



Nonlinear, stochastic systems  
Convex optimization  
Nonlinear programming  
Optimization-based control  
Verification

## Flight Robotics & Perception



Motion planning  
Nonlinear filtering  
Planning and navigation  
Control / Allocation  
Fault detection

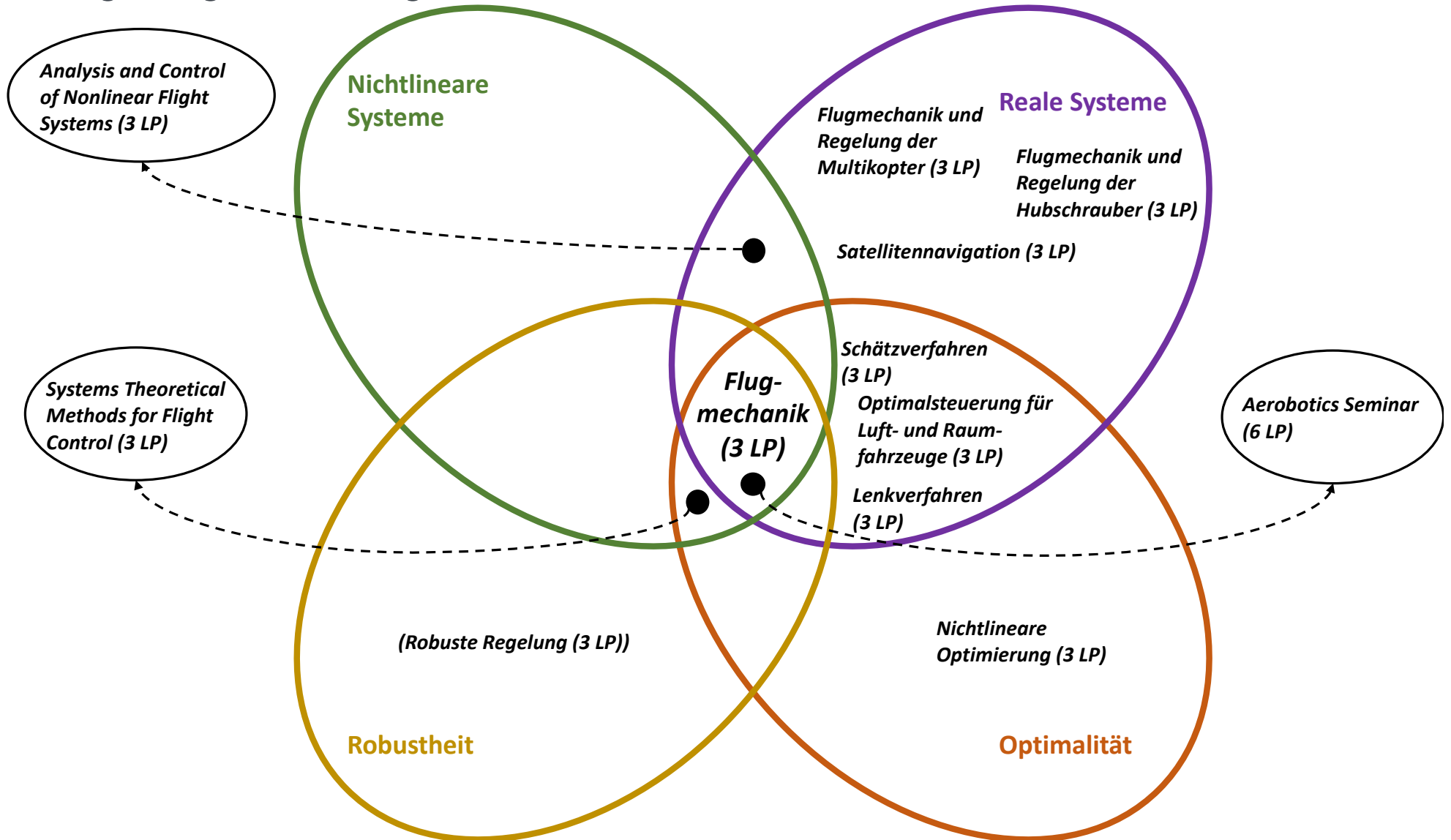
# iFR - Forschung und Praxis

Lehrveranstaltungen

# **Spezialisierungsfach Flugführung und Systemtechnik**

# Lehrveranstaltungen

## Regelung und Navigation



# Lehrveranstaltungen

## Komplexe Systeme

|    | Lehrveranstaltung                                 | Umfang |
|----|---|--------|
| 14 | Komplexe Avioniksysteme I                         | 3 LP   |
| 15 | Komplexe Avioniksysteme II                        | 3 LP   |
| 16 | Methoden der Systemmodellierung und Systemanalyse | 3 LP   |
| 17 | Methoden der Sicherheitsanalyse                   | 3 LP   |

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# Lehrveranstaltungen

## Anwendungsorientierte Luftfahrt-Systemtechnik

|    | Lehrveranstaltung                         | Umfang |
|----|---|--------|
| 18 | Entwicklungsprozess von Luftfahrtsystemen | 3 LP   |
| 19 | Angewandte Luftfahrtsysteme I             | 3 LP   |
| 20 | Angewandte Luftfahrtsysteme II            | 3 LP   |
| 21 | Integrierte Modulare Avionik              | 3 LP   |
| 22 | Auto-Flight und Air Traffic Management    | 3 LP   |



# Lehrveranstaltungen

## Kombinierte Module

|          | Lehrveranstaltung                                   | Umfang      |
|----------|---|-------------|
| <b>1</b> | <b>Flugregelungssysteme</b>                         | <b>6 LP</b> |
|          | a. Flugregelungsentwurf                             |             |
|          | b. Systementwurf II                                 |             |
| <b>2</b> | <b>Nonlinear Flight Control Systems</b>             | <b>6 LP</b> |
|          | a. Analysis and Control of Nonlinear Flight Systems |             |
|          | b. Systems-theoretical Methods for Flight Control   |             |



**Vielen Dank!**



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