



# **DLR Institute of Flight Systems**

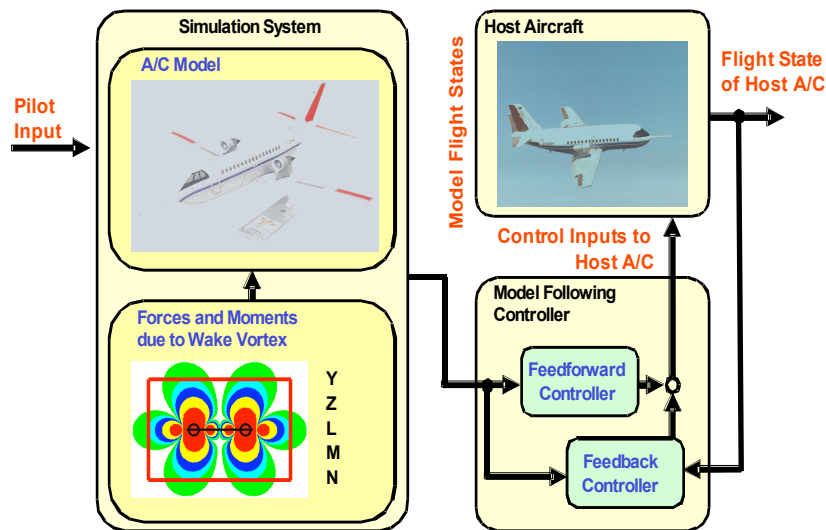
On-going Efforts and New Projects

SAE AGCSC Meeting #97

Dr. Frank Thielecke, Joerg Dittrich

# Inflight-Wake-Vortex-Simulation

- IFS preparation: Instrumentation, Modelling, HITL-Simulation



Inflight Wake Vortex Simulation



ATTAS wake vortex

PoC: Klaus-Uwe Hahn

# Electronic Flight Control System Rig (EFCS)

- ▶ **Hard real-time closed-loop-simulation (dSpace)**
- ▶ **Completion of a 5000 psi hydraulics system**
- ▶ **Various control surfaces have been connected**

**2006 Implementation of an Airbus-type FCS**

**2006 Setup of a dynamic loads simulation**

**2006 Completion of the initial setup of the EFCS-Rig facility**



Display

**PoC: Holger Spangenberg**

Überblick

Aktuatoren

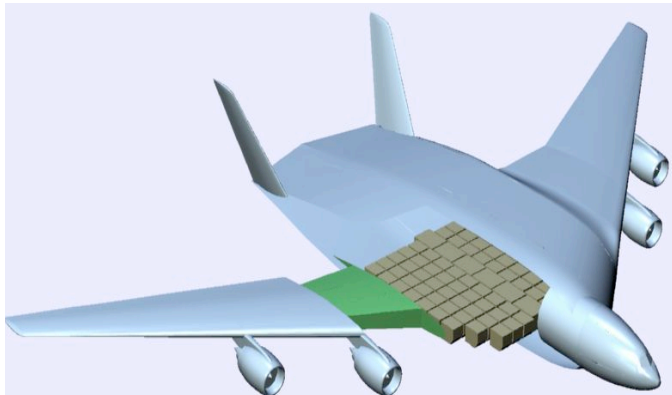


# New Flight Control Concepts - Blended Wing Body

- ▶ Conceptual analysis of flight control concepts
- ▶ Controller synthesis, primarily for stabilisation
- ▶ Stability- and controllability analysis

2006 Pilot-in-the-Loop Simulations using the EFCS-Rig

2006 Knowledge transfer to EU-Project NACRE



PoC: Mr. Aitor Iniguez



# Active Control Inputs / Cargo Handling

Active Side Sticks for the FHS Helicopter

- **Conception, Selection & Purchase of a right hand side stick**
- **Integration design and construction**

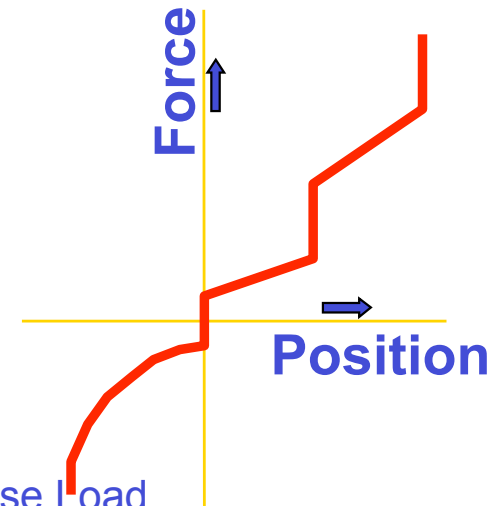
2006++:

- Integration of r.h. side stick,**
- Conception and Integration of l.h. side stick**
- Realization of basic functionalities**
- Mission-oriented evaluation of tactile cueing**

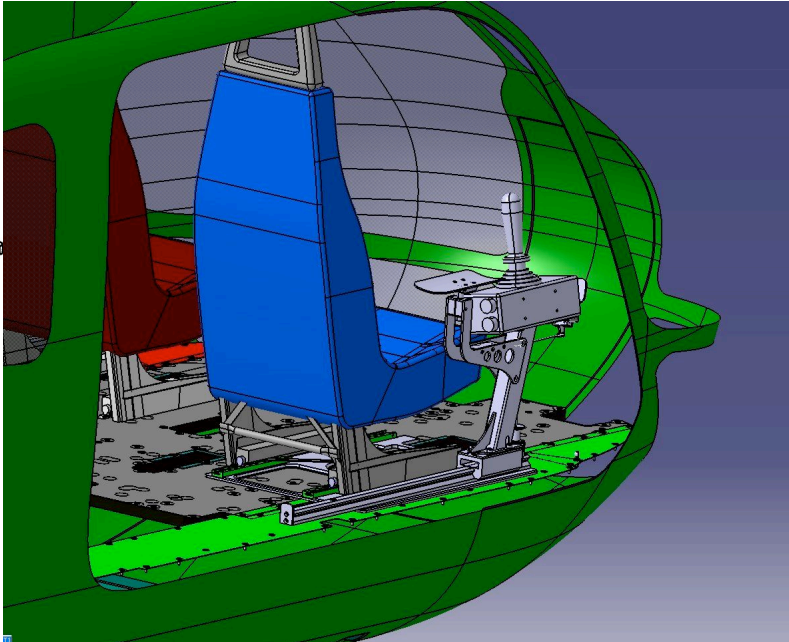
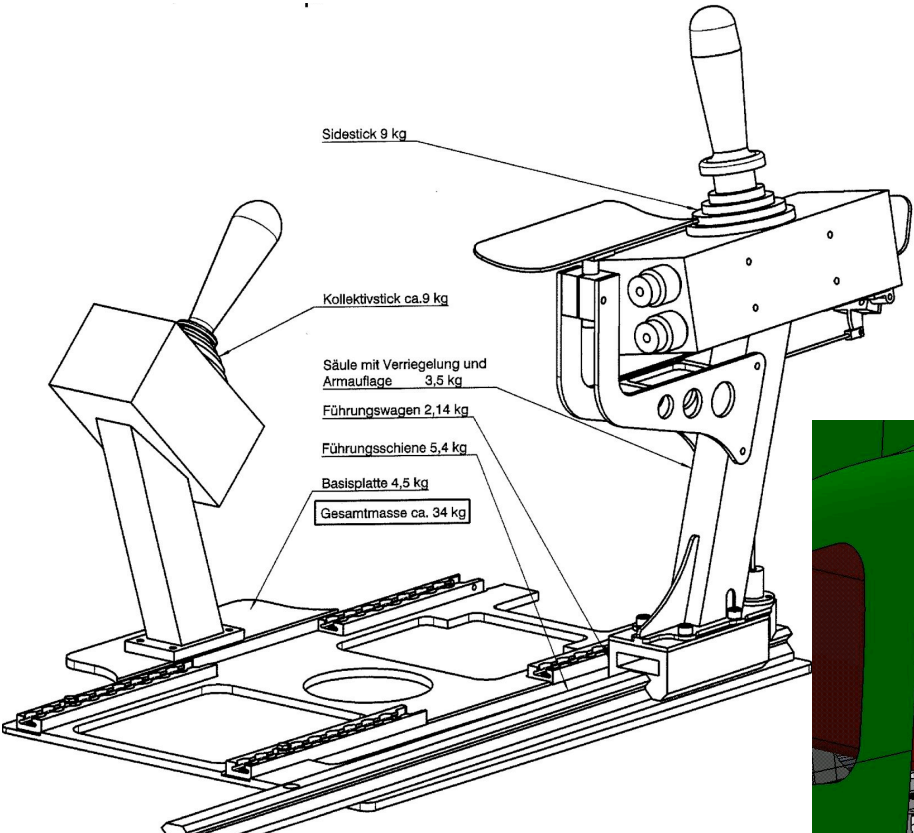
Cargo Handling / Slung Load

- **Evaluation of a 2-axis display (Flight Director)**

2006++: CH 53 flight tests, Extension for vert. axis, Precise Load Positioning



# Sidesticks for Helicopters



## FHS - Integration

# Evaluation Maneuvers for Side Stick Controls



Slung Load



"Pirouette"



Sloped Landing Sites

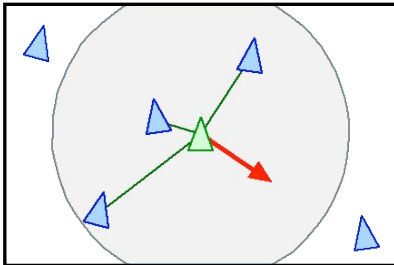


International Team

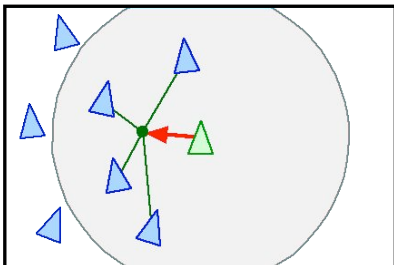
**PoC: Mario Hamers, Marc Höfinger**

# Simulation of Swarming Behavior for UAVs

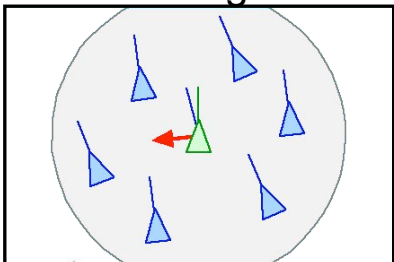
Collision Avoidance



Cohesion



Swarm Alignment



## ► Old Stuff:

- Classical swarming rules with point-mass airplanes
- Basic Algorithms for trajectory tracking
- 3D and scalable number of vehicles

## ► New stuff:

- Still the same rules
- But: on-going evaluation of the applicability for real aircraft: GARTEUR Workgroup (EU)
- Simulation with real-world dynamics!

Swarm Formation

Separation



# New UAV Helicopter System - maxiARTIS



# Specifications - maxiARTIS

## Airframe

- ▶ Rotor diameter: 3m
- ▶ MTOW: 25 kg
- ▶ 1 mini turbine, 6 h.p.
- ▶ Controllable through safety pilot

## Payload

- ▶ 4 kg GNC Avionics
- ▶ Max 6 kg experimental payload
- ▶ Identical payload mounting system to older ARTIS UAV

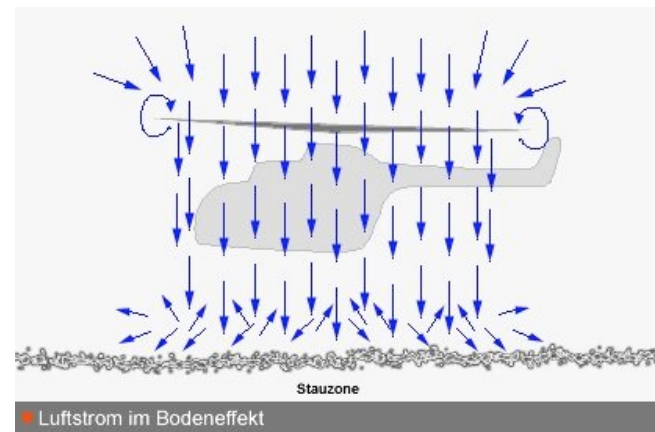
UAV System is currently undergoing first flight tests



**Video**

# Ground and Ground Effect Modelling for ARTIS UAV Simulation

- ▶ Integration of ground interaction forces into the model
- ▶ Primary aerodynamic effects in ground vicinity (ground effect)
- ▶ Add-On to the ARTIS flight physics model



Video!

[Ground Interaction](#)

[Ground Effect](#)

# Manned-Unmanned Teaming Simulation

Fully coupled Hardware-in-the-Loop simulation environment

