
# Project Update 2005
# German Aerospace Center (DLR)
# Institute of Flight Systems

**presented by Frank Thielecke**

Deutsches Zentrum
für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft

# New Focus on Systems Automation…

## New Research Groups

- System Identification
- Signal and System Analysis
- Image Processing Methods
- Control and Decision Systems
- Information Technology

## Current Projects

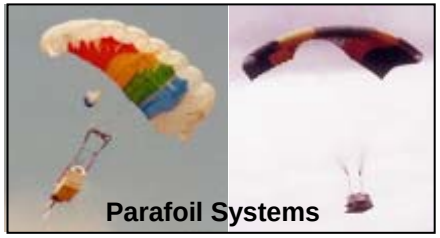
- Modeling and analysis of high lift systems (*IHK)*
- Health monitoring and diagnosis (*THSA, MOET)*
- Modeling of extreme flight conditions (*HAFUN)*
- System identification of flexible aircraft (*MODYAS)*
- Experimental studies for model validation (*SIVA)*
- Failure detection and fault tolerant control (*Garteur AG 16)*
- Autonomous Helicopter (*ARTIS)*
- *….*

Large flexible Aircraft

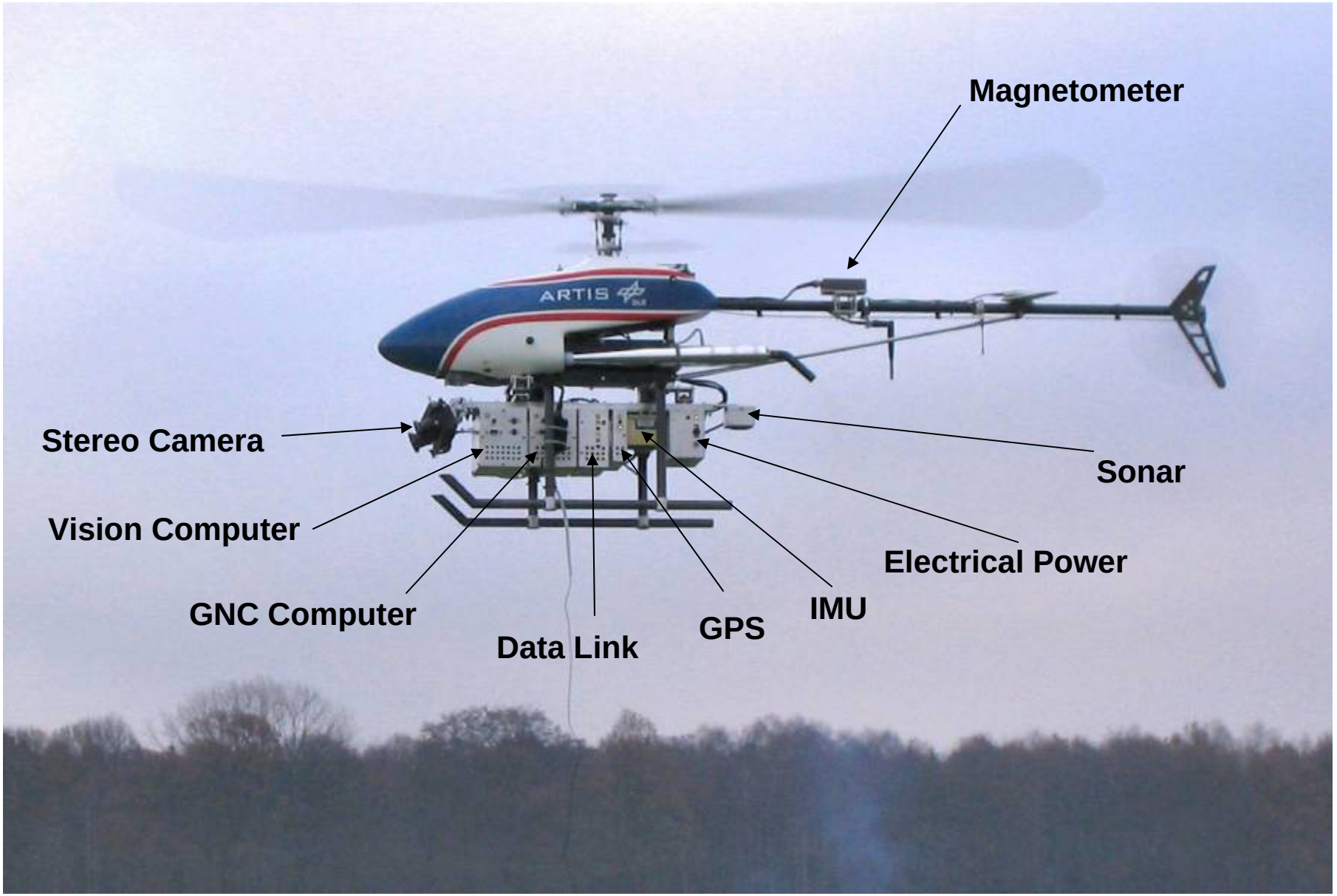
High Lift & Cabin Systems

Reusable Launch Vehicle


UAVs

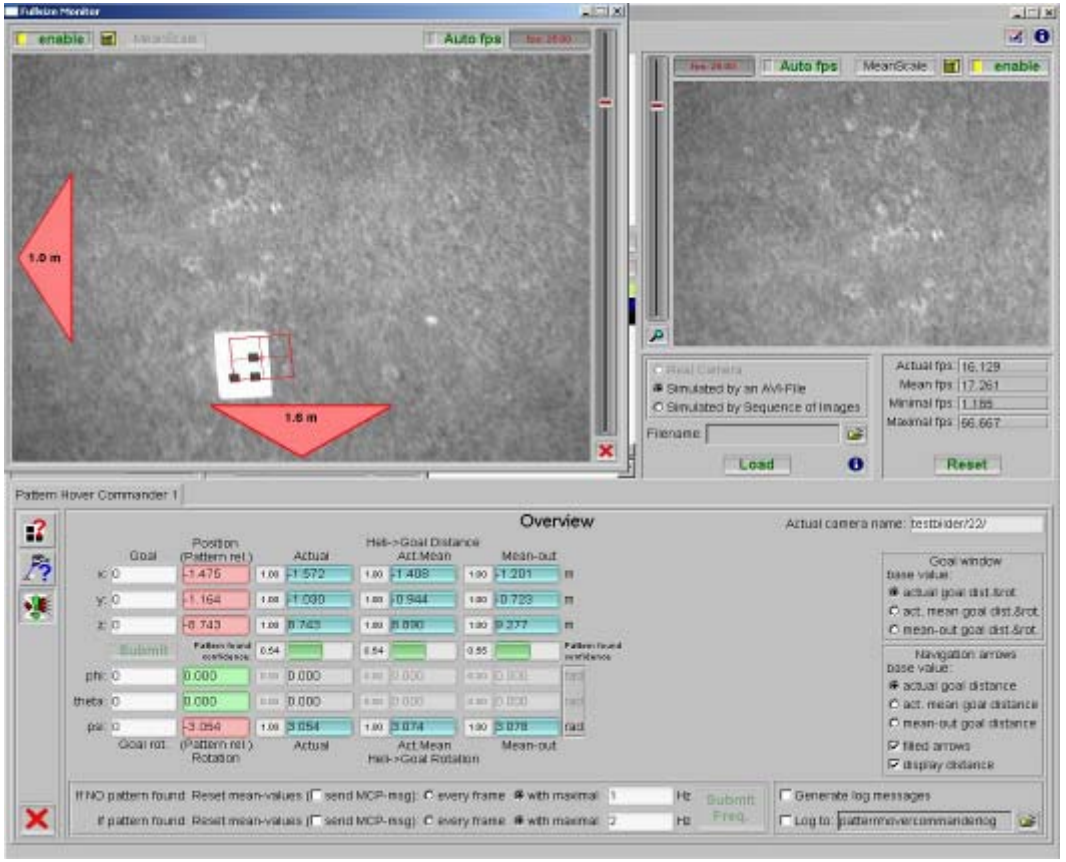

Parafoil Systems

# ARTIS – Autonomous Helicopter



# Vision-based Tracking of a Moving Target

- Development and evaluation of pattern tacking methods
- Test in HITL simulation incl. cameras
- First flight tests with ARTIS helicopter

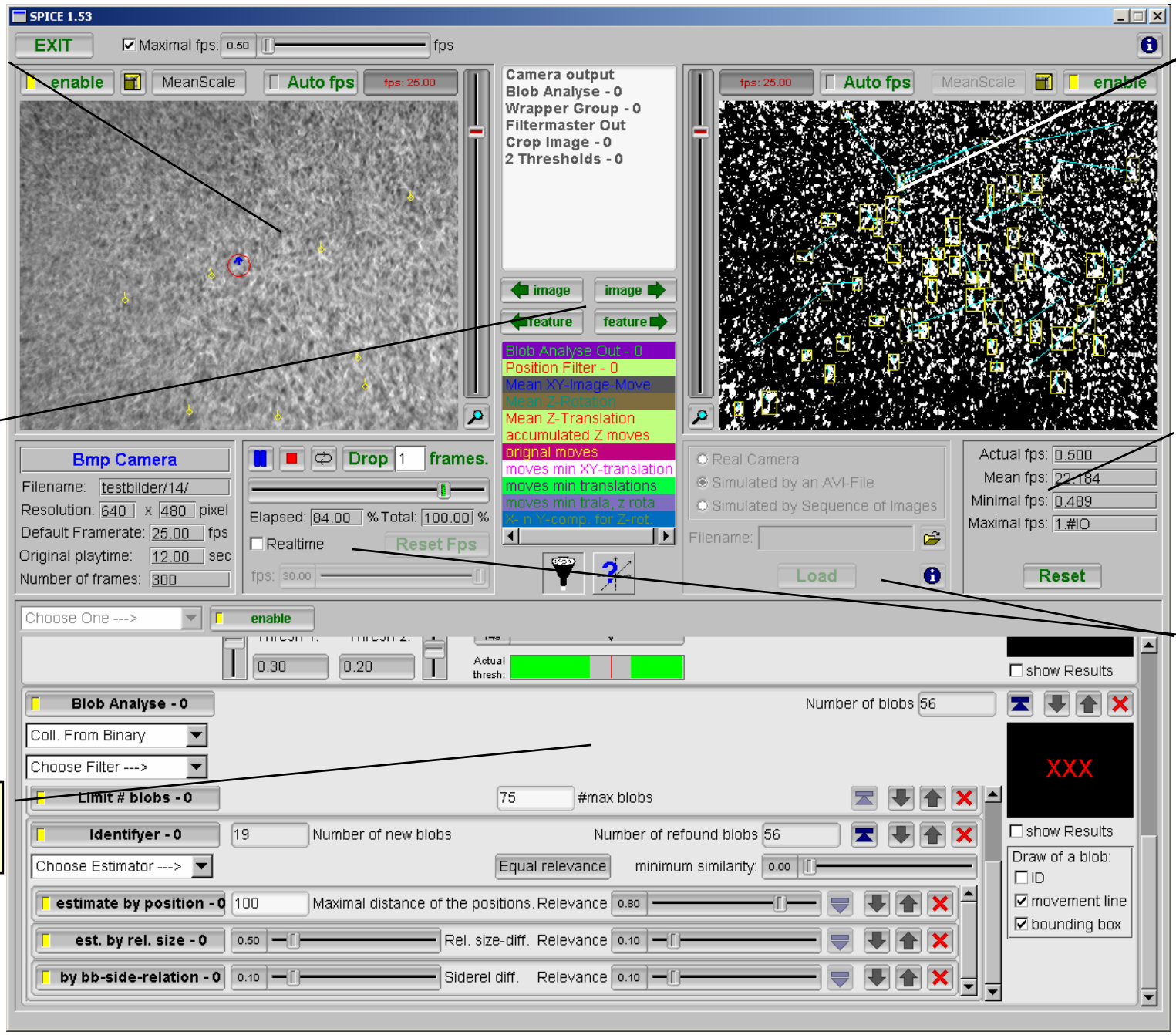


# Framework for Image-Processing Experiments

**Monitor 1:**
Original Image, presentation of calculated results

**Selection of source/output**

**Filter Configurations**




**Monitor 2:**
Image processing level with internal results

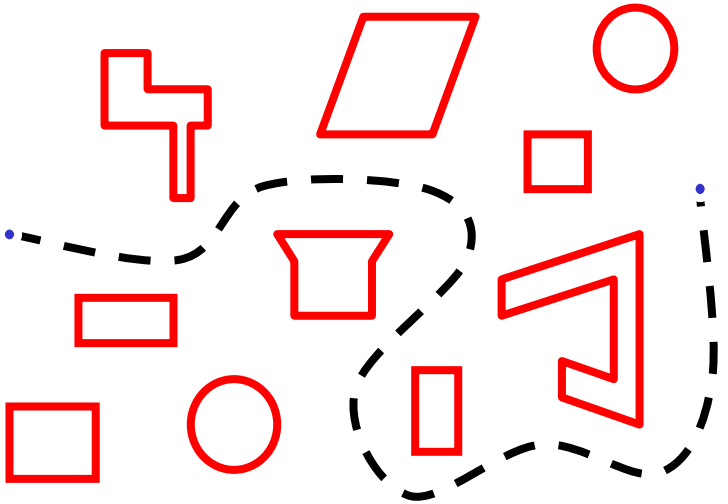
**Output of Frame Counter**

**Controls for each camera**

# Global Path Finding Problem for ARTIS

## Situation:

- Team of UAV agents
- Set of tasks in different positions, each requiring only one agent
- Unknown or partially known environment
- Moving obstacles

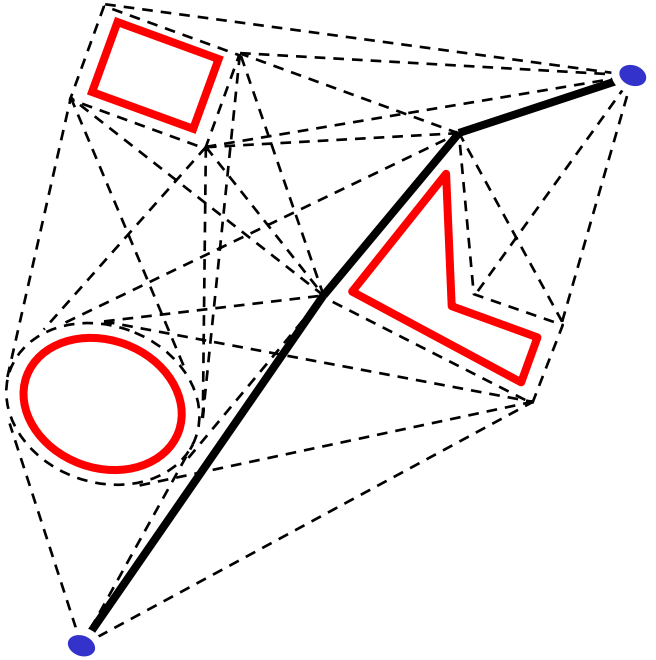


## Problem:

- Gobal path finding algorithm?
- Local dynamic collision avoidance?

## Visibility Graph Algorithm:

- More intuitive final path compared to Voronoi graph
- Shortest path
- Control over safety distance




# Path Planning & Obstacle Avoidance

## Simulation Samples

*Visibility path reconstruction*

*Dynamic collision Avoidance 1*

*Dynamic collision Avoidance 2*

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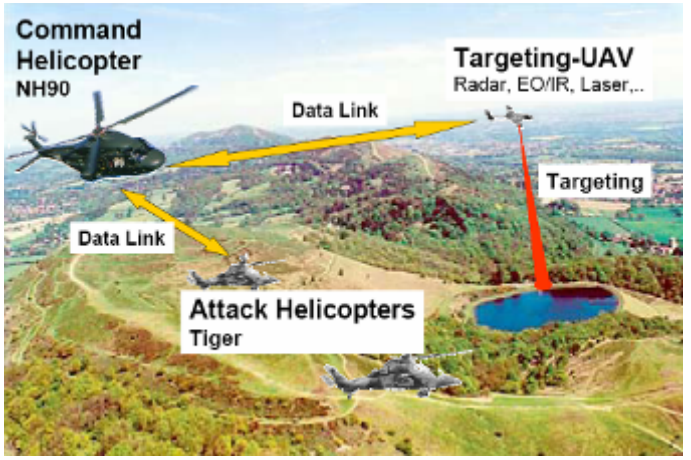
# Manned-Unmanned Teaming

- Future combat helicopter pilots could enhance their tactical advantages through manned/unmanned teaming.
- Operation of an effective combat system of system to increase the arms team's battlefield effectiveness
- Provide pilots with valuable information transmitted from an unmanned system to locate, identify and target the enemy.
- Explore the capabilities of teaming, identify technological and operational needs and validate the expected teaming benefits.
- Goal: A companion UAV that acts as an electronic wingman




# Voice Control for Manned-Unmanned Teaming

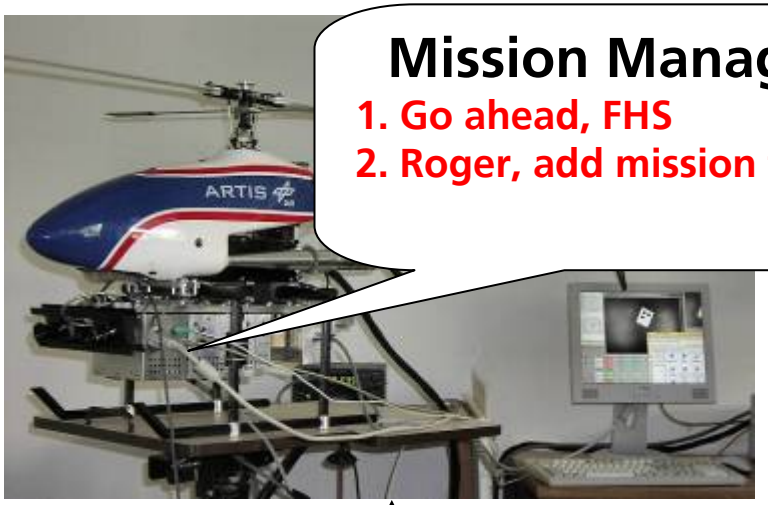
- Study the opportunities and challenges in applying speech recognition techniques for the control and command of unmanned aerial vehicles (UAVs) in the context of teaming

- Motivation
  - Use of a multi-modal pilot-machine interface for the communication of pilots with the UAV´s on-board mission manager

- Work Package
  - Definition of demonstration scenario and generation of syntax for Teaming-Voice Control
  - Implementation of an interface to the speech recognition software
  - Tests with German pilots/operators speaking English
  - Performance evaluation using the Hardware-in-the-Loop Simulation

# Voice Control Simulation & Test Infrastructure

**Operator**
1. ARTIS – this is FHS
2. Add new mission task
3. FHS - out




**Mission Manager**
1. Go ahead, FHS
2. Roger, add mission task

**FHS Vehicle Simulation**

Sim Link Protocol

**ARTIS Vehicle Simulation**

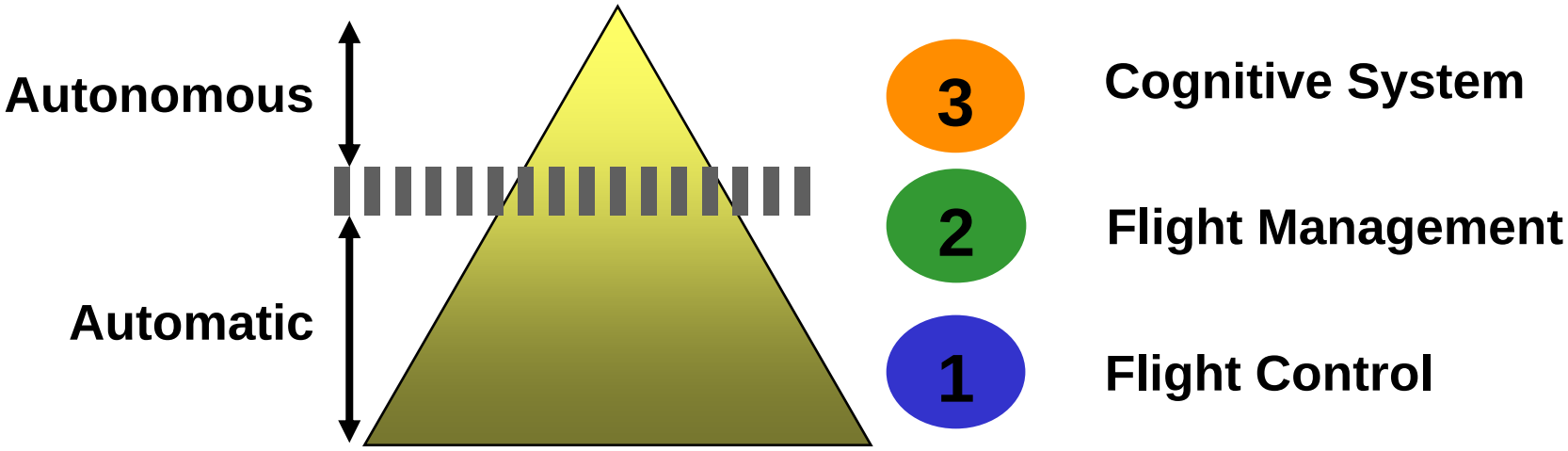
**FHS Hardware**

Data Links

**ARTIS Hardware**

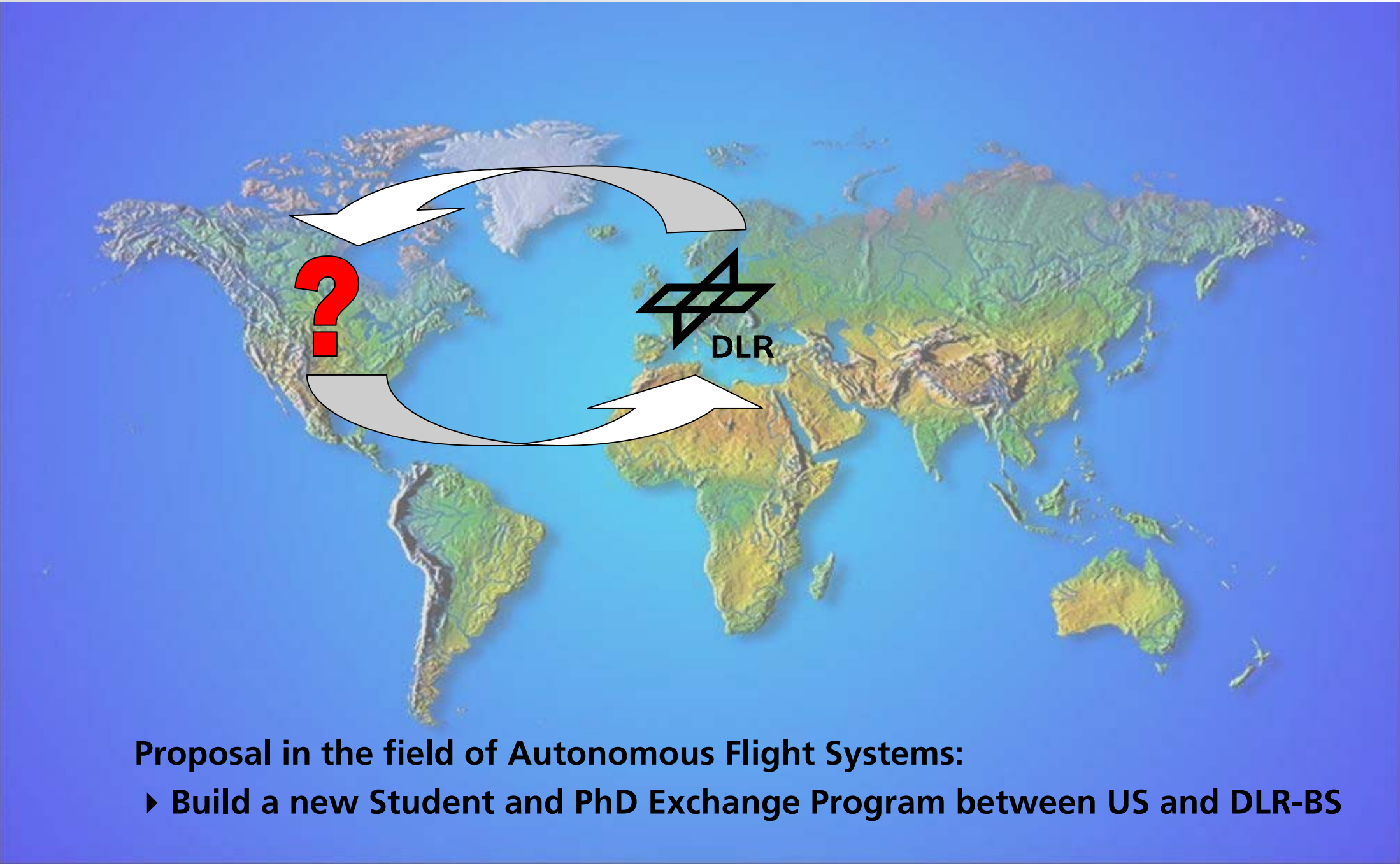
# UAV challenge: Cognitive System

- What is Autonomy?
  - Dictionary ≈ “self-governing” or “independent”




- Autonomy in UAVs:
  - decision making capability to solve problems during operation, with minimal dependency on human interaction, while operating in an uncertain environment.

# Extend the International Network...




**Proposal in the field of Autonomous Flight Systems:**

- **Build a new Student and PhD Exchange Program between US and DLR-BS**