Concept Realisation Laboratory

FluMeS and Machine Design

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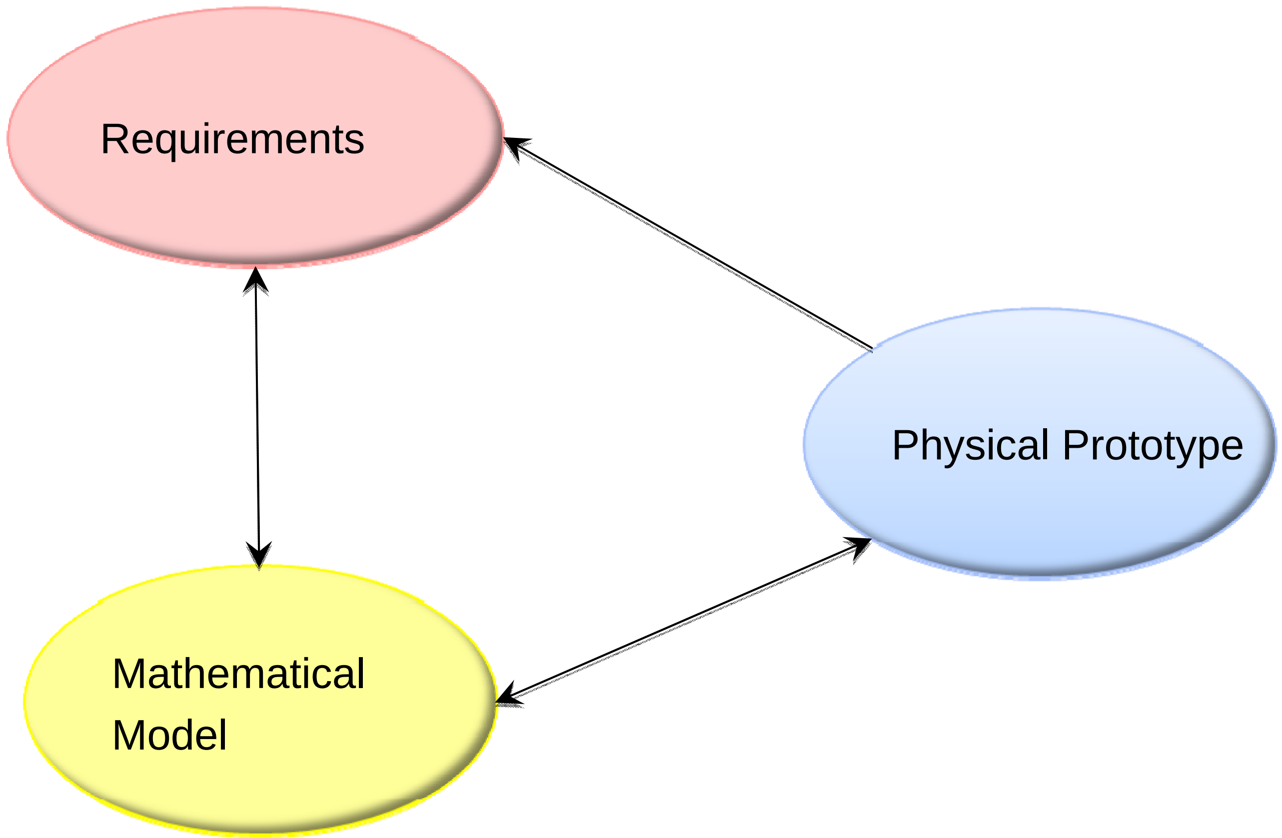
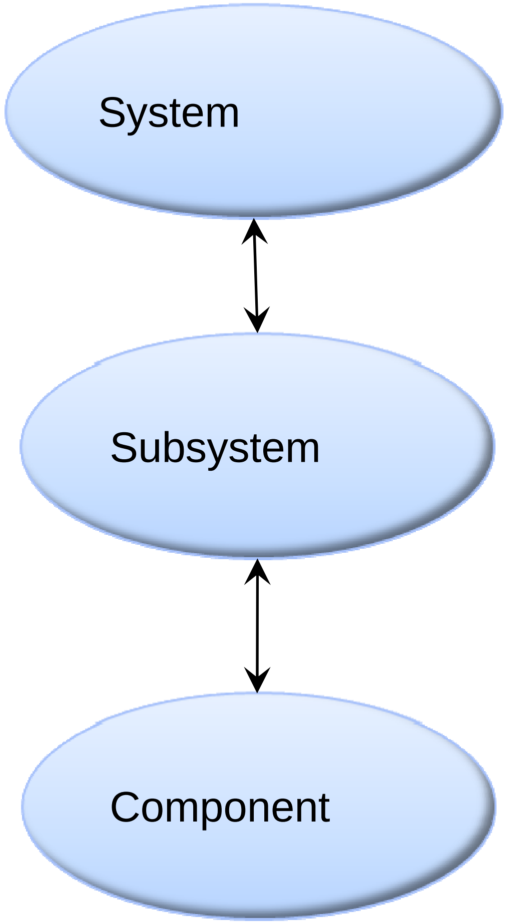
Machine Design/Flumes
Research philosophy



Machine Design/Flumes
Vertical Integration



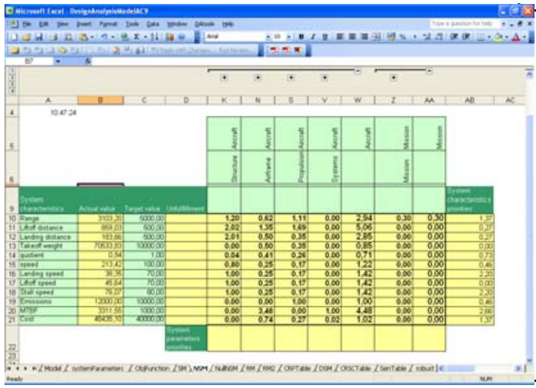
Increased Intelligence in Products

- New products tend to have more intelligence than before. This apply to a wide range of products. This is particularly true for the CRL application areas:
  - Cars
  - Aircraft
  - Construction Machinery
  - Industrial Manufacturing Systems


Technologies

- These kind of systems are characterized by a close coupling between:
  - Mechanical system
  - Power transmission/Actuation systemSensors
  - Control System
- *This requires multi domain co-design.*

Strong Trend Towards Multi Domain Analysis and Optimization



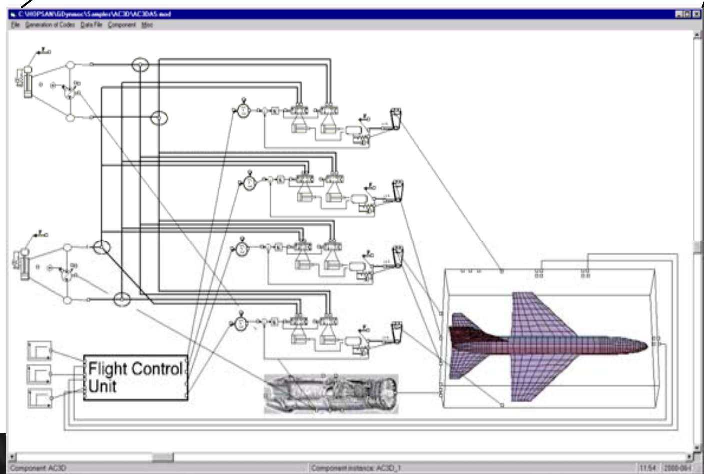
Spread sheet with design analysis and optimization tools

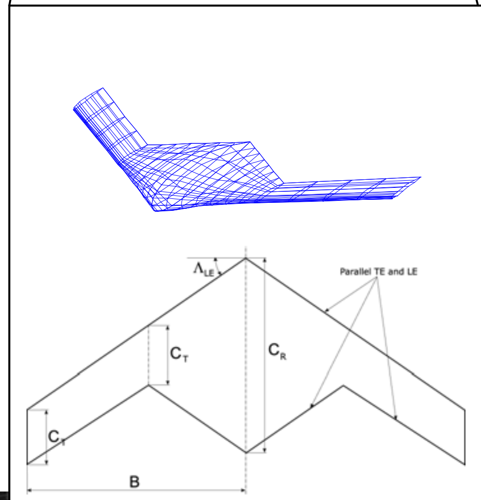
Integrated system model

Simulation model

Other analysis model

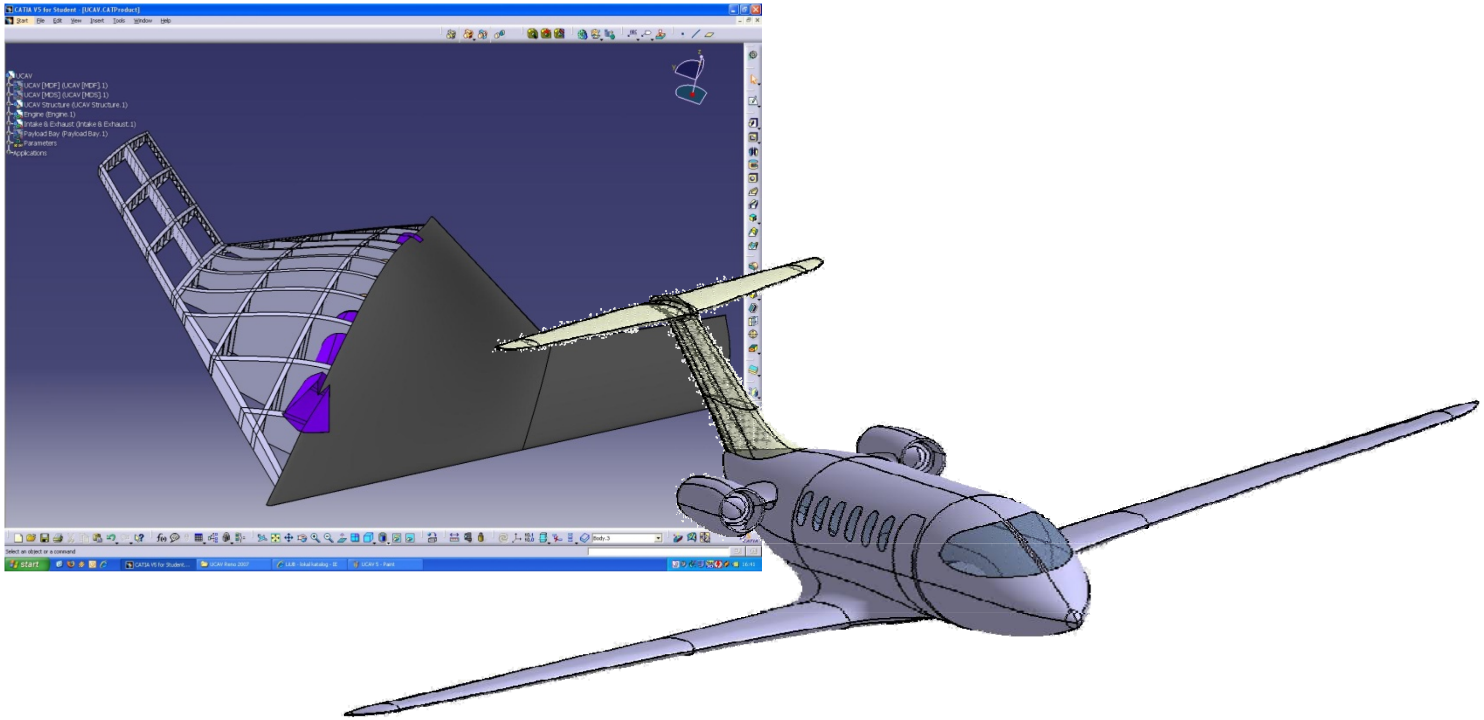
Integrated system analysis of an aircraft with both a aerodynamic model and a simulation model



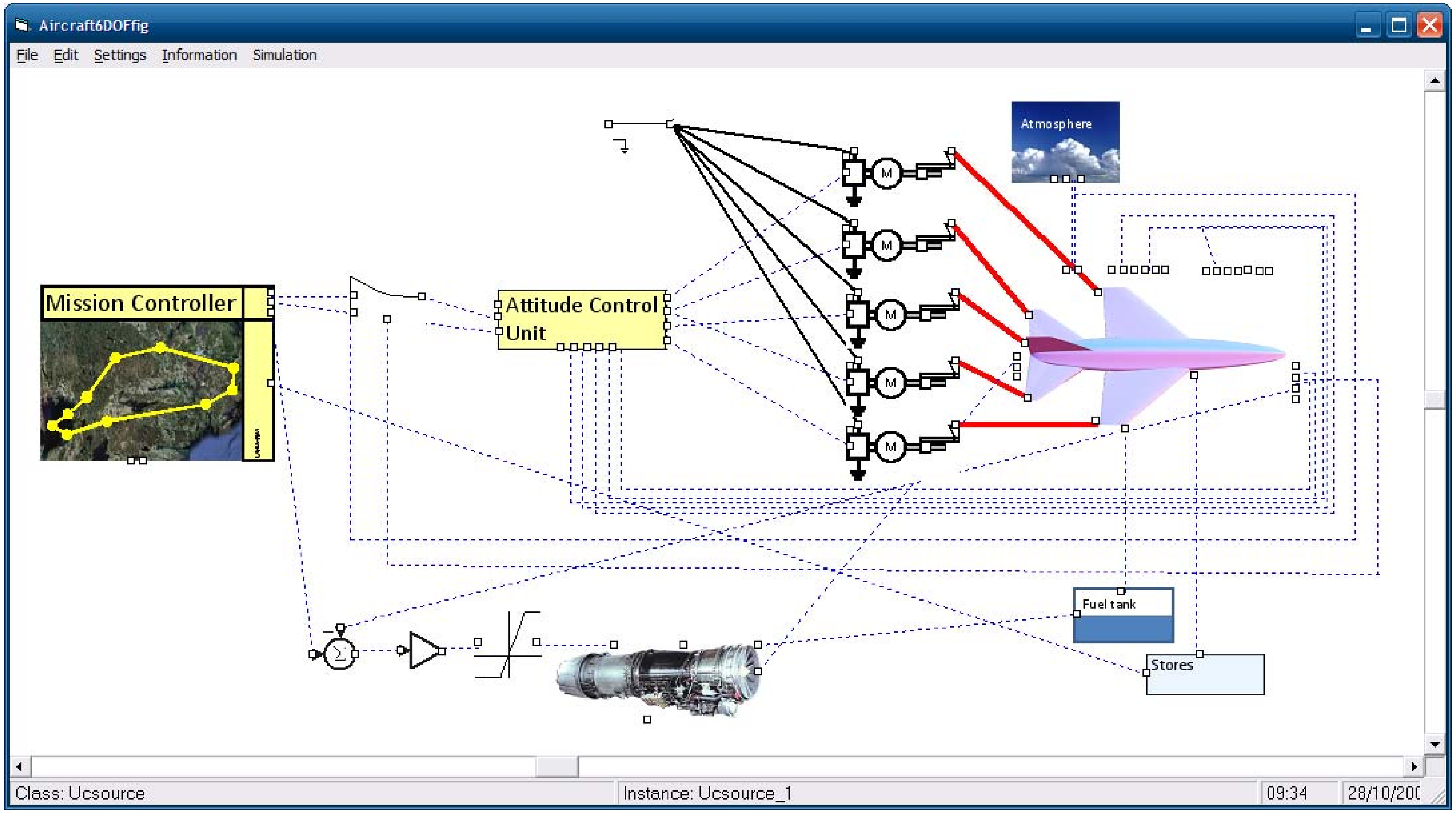


CAD-Design Automation, Knowledge Based Engineering.

Develop methodologies for next generation CAD-software



Full Mission Simulation for Aircraft Design



Towards Full Mission Simulation for Aircraft Design

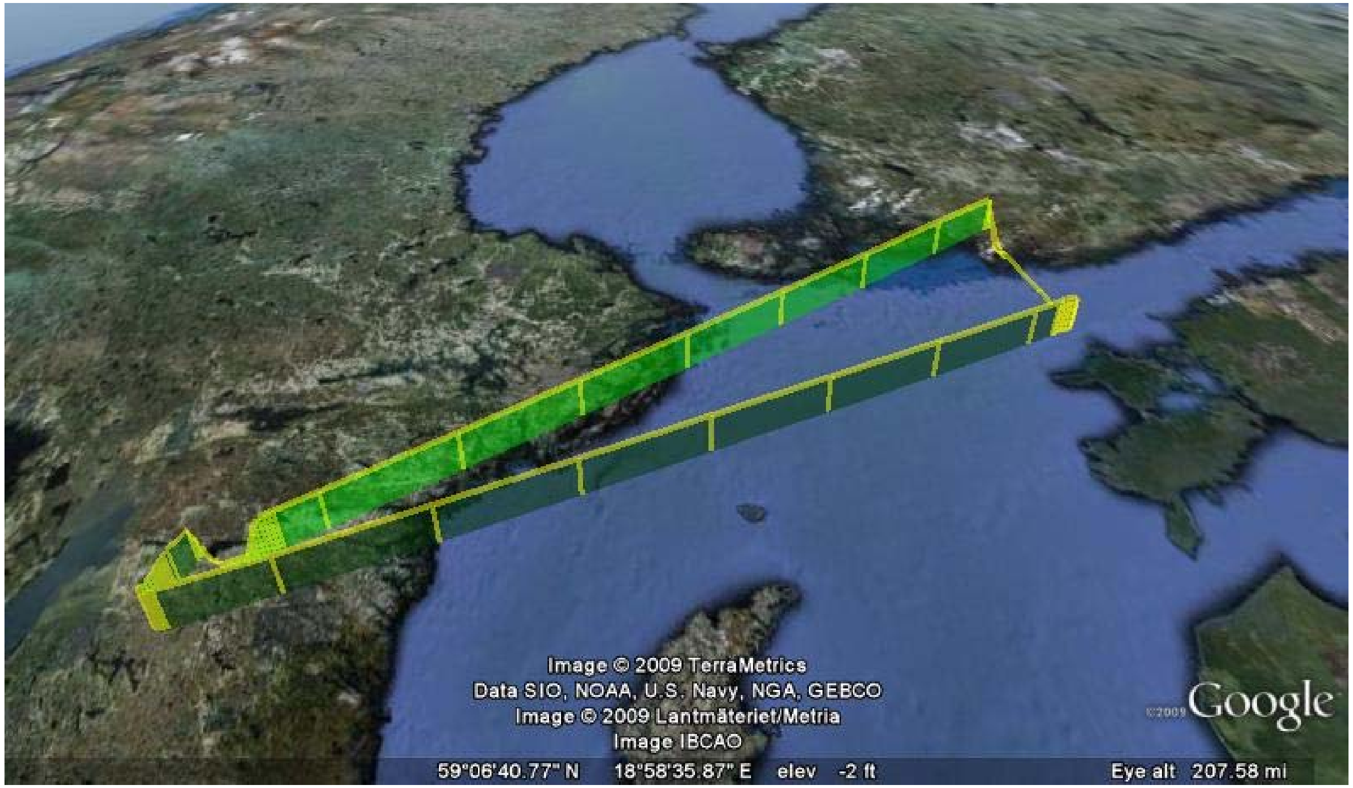


Figure 5. Simulated flight path (Furthest distance about 45 km from start point). Altitude scale is amplified 20 times for the plotting.

(6000 sec simulated in 105 seconds (normal PC), time step 0.01 sec)

Simulation in Heavy Vehicles

Project Examples

- Energy Efficient Hydraulic System (Volvo CE, Parker)
- Hybrid Systems (Volvo CE)
- Sensorsystems for Trucks (Scania)
- Advanced Trajectory control (Scania)
- Aircraft Systems (Airbus Saab)
- Design Optimisation for Industrial Robots (ABB)
- High Speed Simulation (Volvo CE, Atlas Copco, CybAero, Prevas, National Instrument)

High Speed Simulation for Product Design and Operation - HiPO

-*Using the same models throughout the lifecycle*

System level design

System simulation for design optimization and analysis
High Speed Simulation HSS

Human in the loop simulation, *Real time simulation RTS*

Subsystem design

System simulation for design *HSS*

Hardware in the loop simulation *HWIL, RTS*

Prototype testing and evaluation

Dynamic testing using HWIL, *RTS*

Operation

Training simulators, *RTS*

Embedded simulation models for condition monitoring and control
RTS and faster than real time simulation, FRTS

Mission planning
Faster than real time simulation, FRTS

Industrial Partners and Applications

Helicopters

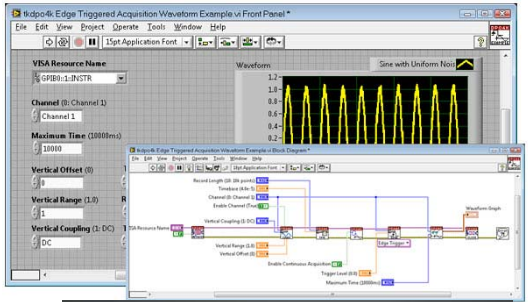
Cybaero AB

Construction Machines

Volvo CE

Rock drills

Atlas Copco

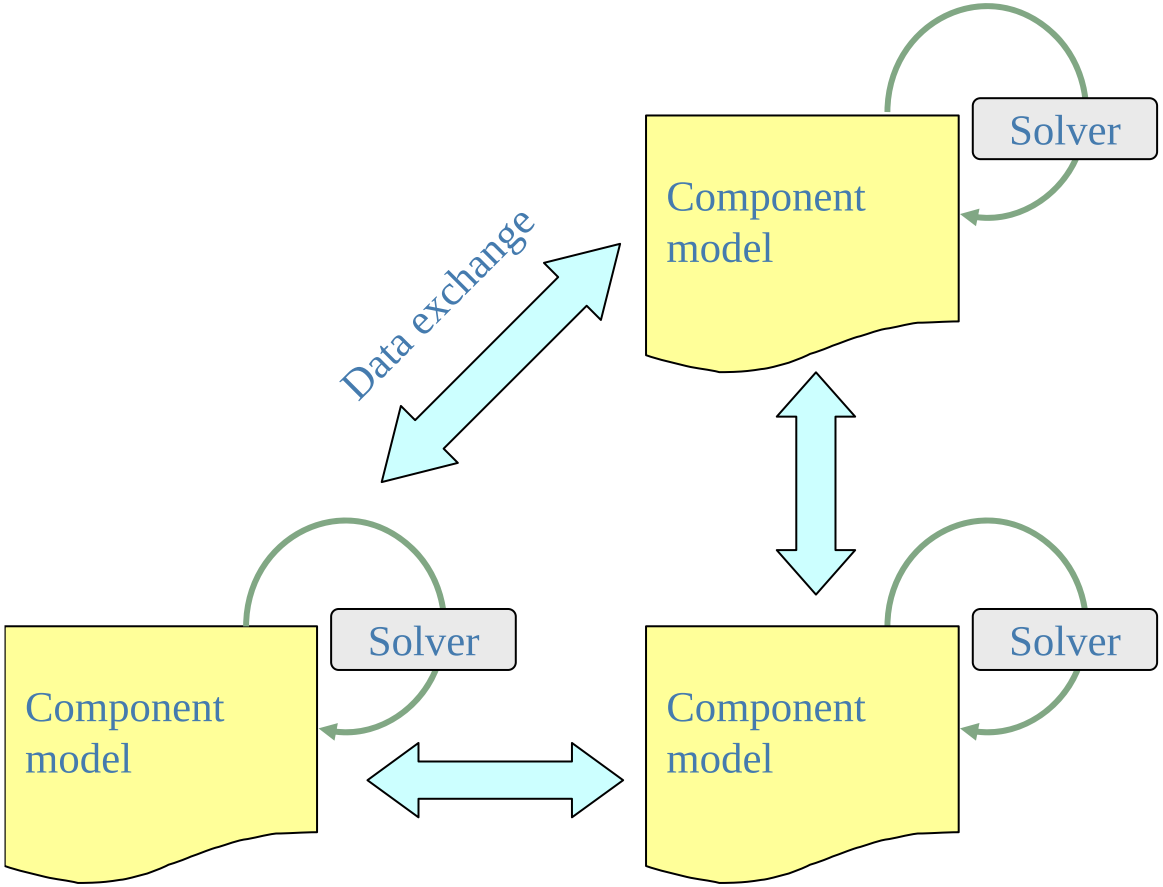


Hardware in the loop systems

Prevas,

National Instrument

Distributed modelling using transmission lines

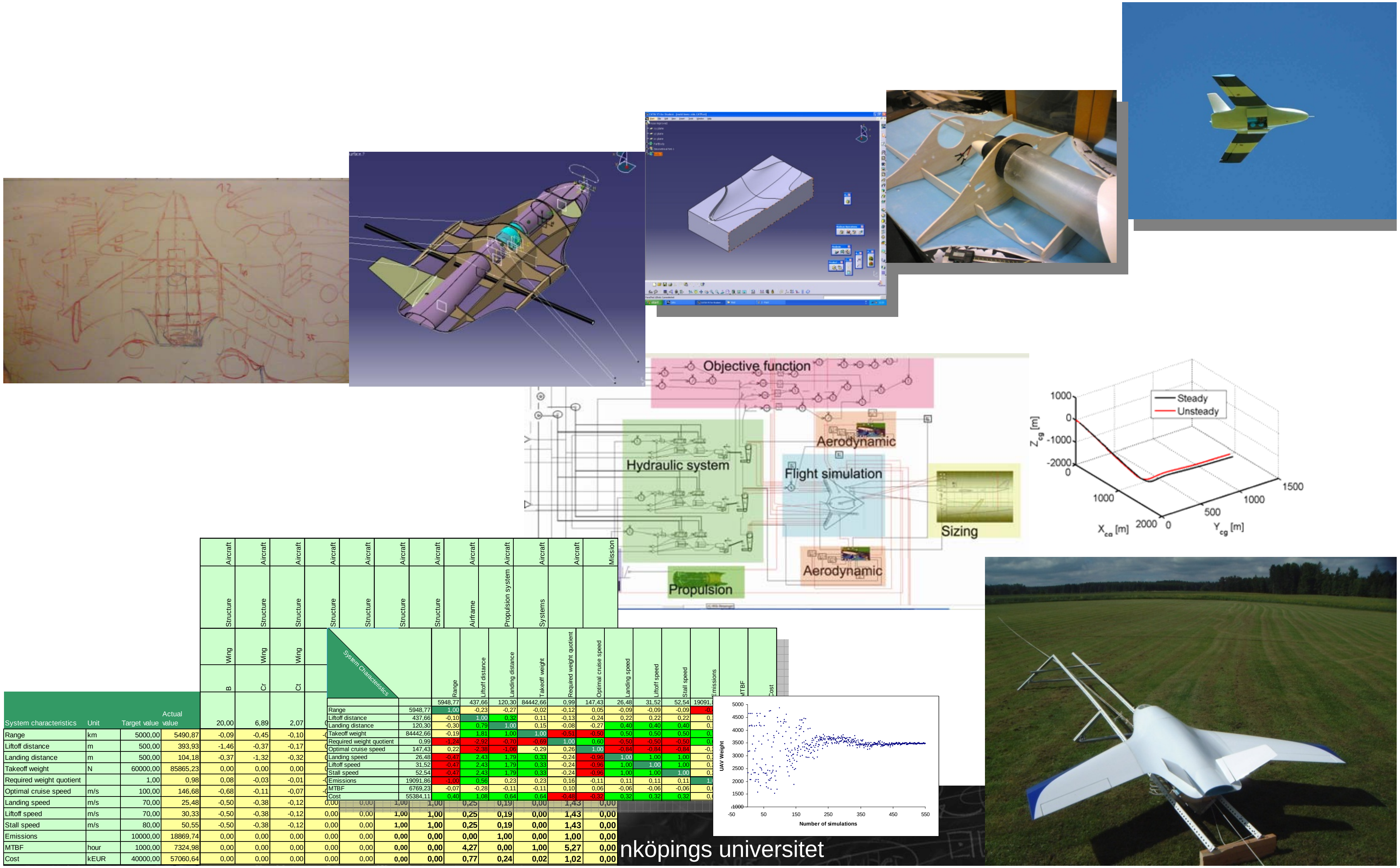


Maintain the physical structure of the system in the model

Use the finite signal propagation speed to numerical advantage

Distributed solver and allows for *distributed* processing

From sketch to physical prototype in 5 months



2008 *GlobaLiTH*
Light electric utility vehicle for development countries

13:34:31

System characteristics	Units	Target value	Actual value	Motor power	Chassi cost	Safety weight	Battery weight	System characteristics priorities
				18397.90	27816.31	20.00	61.33	
Range	km	40.00	46.89	-0.07	0.14	-0.07	0.76	1.26
Acceleration (0-70)	s	8.00	5.44	0.06	-0.14	0.08	0.24	1.12
Top speed	km/h	100.00	135.76	-0.02	0.05	-0.02	-0.08	1.12
Recharge time	As Y	1.00	1.00	0.00	0.00	0.00	0.00	0.89
Handling	As X	1.00	1.00	-0.10	0.20	-0.11	-0.34	1.71
Safety level	As X	1.00	1.00	0.00	0.00	0.95	0.00	0.89
Running cost/km	EUR/km	2.00	0.11	0.07	-0.14	0.07	0.23	0.45
Emissions	As Y	1.00	0.00	0.00	0.00	0.00	0.00	1.12
Cost	SEK	50000.00	58804.53	0.44	0.47	0.00	0.09	0.45
			System parameters priorities	0.58	1.00	1.28	2.03	

Winners of Formula ATA Electric and Hybrid Vehicles, Class 2, Rome 2009.