

Heli Life Cycle Cost Reduction

through Pre-Design Optimisation

Session 4



VIVACE

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- Objective
- Pre-Design sizing tool (NLR)
- Life Cycle Cost model (Eurocopter)
- Demonstration of integrated tool
- Conclusions



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Objective (1)

Helicopter Life Cycle Cost reduction through Pre-Design Optimisation

- Current practice:
 - pre-design driven by **performance requirements**
- Objective to find optimum helicopter design which:
 - complies to performance requirements **and**
 - satisfies the **customer's requirements at lowest costs.**



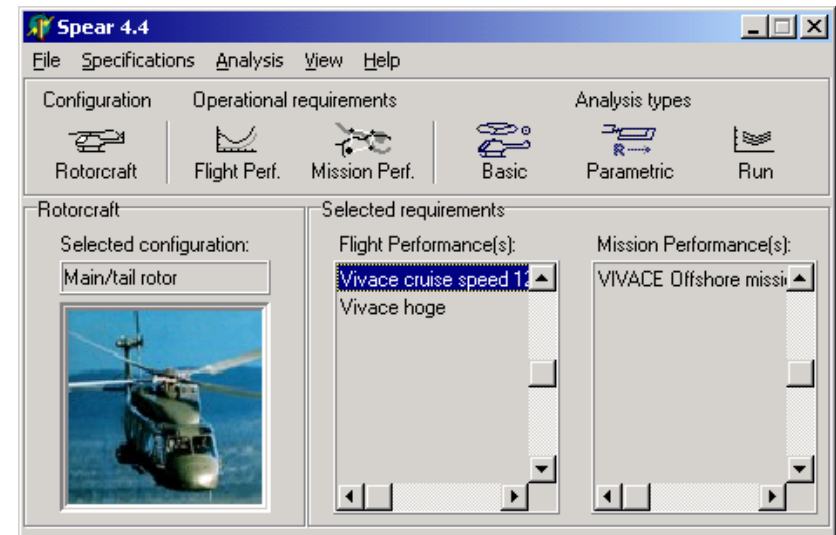
Objective (2)

VIVACE heli MDO target group

- Manufacturers
 - can **optimise helicopters** for **lowest LCC** for the operators and thus improve their sales
 - **assist operators** in selecting the optimum helicopter
- Operators
 - can **perform case studies** and determine the optimum helicopter for evaluation purposes during procurement

SPEAR

- SPEAR = SPEcification Analysis of Rotorcraft
- Specification analysis and pre-design sizing tool
- Contains large amount of historical information
- Potential for Life Cycle Cost optimisation and trade-off studies

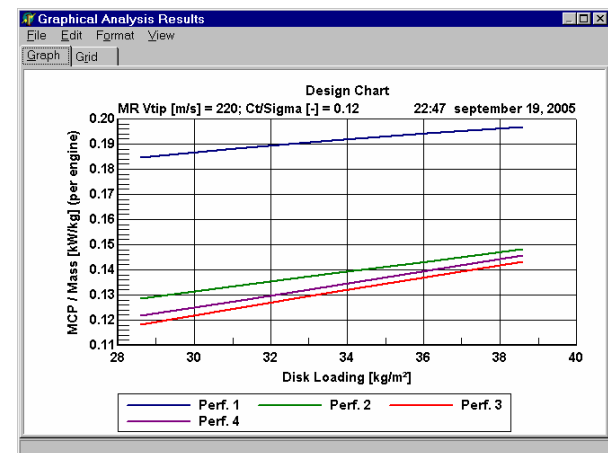




Pre-Design Sizing Tool (2)

SPEAR capabilities

- Determines gross mass, main dimensions, installed engine power, fuel capacity, and the mass breakdown for main components
- Consequences of operational requirements
- Trade-off studies
- Effects of technological developments on optimal rotorcraft mass and size



SPEAR methodology

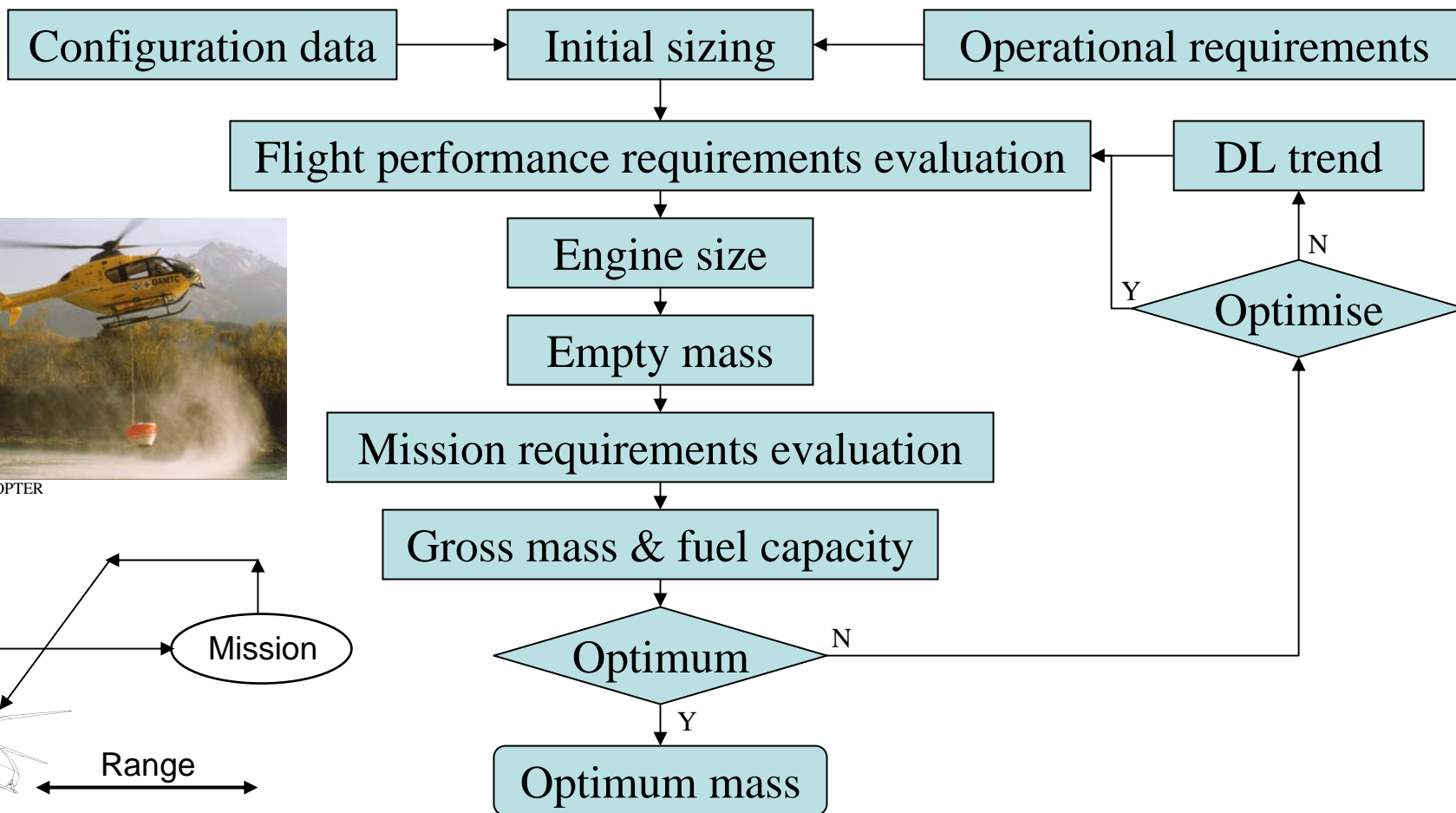
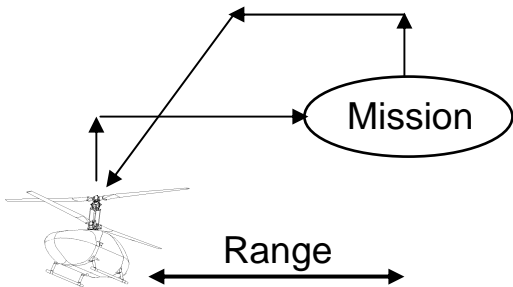


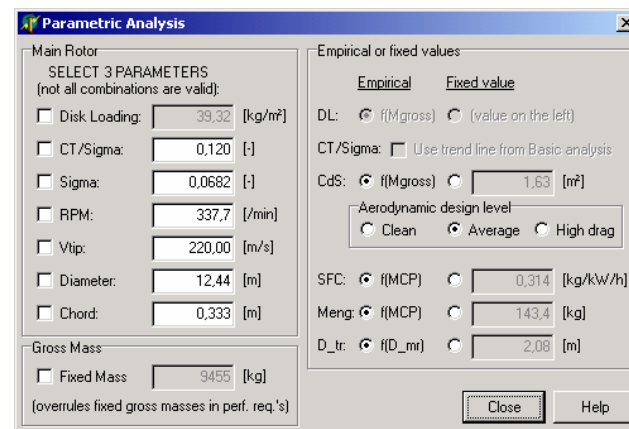
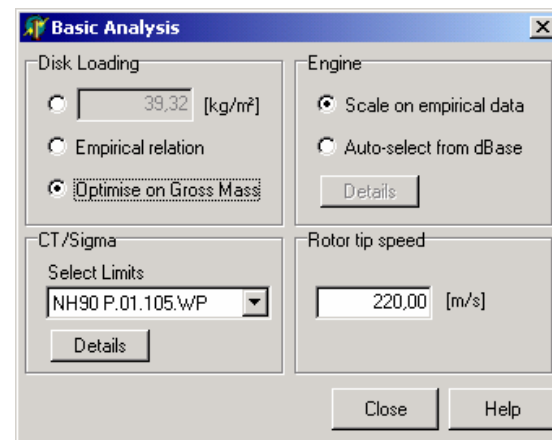
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SPEAR functionality (1)

- Basic analysis
 - main and tail rotor characteristics
 - selected engine (from database or scaled)
 - rotorcraft gross mass and mass breakdown

- Parametric analysis
 - analysis of the effect of varying main rotor parameters



SPEAR functionality (2)

- Graphical analysis

- Design chart

- power required or gross mass vs. disk loading

- Parameter analysis chart

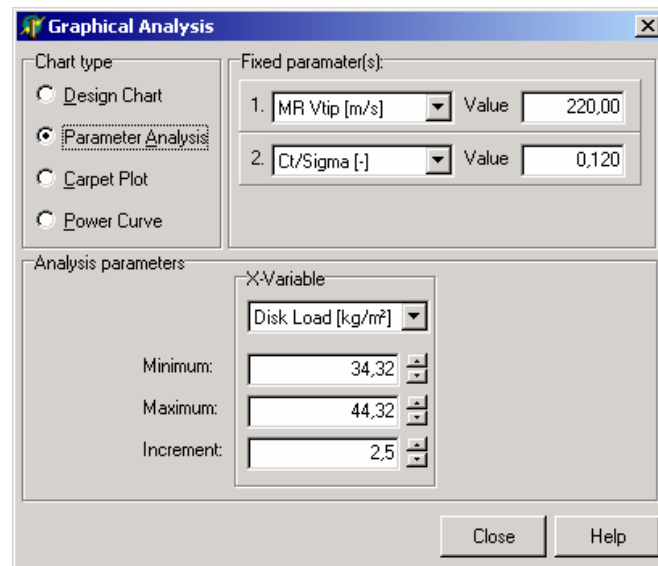
- mass or power required vs. one of the 7 main rotor parameters

- Carpet plot

- mass or power required vs. two of the 7 main rotor parameters

- Power curve

- power required vs. airspeed for given values of gross mass, altitude and temperature



Life Cycle Cost model (1)

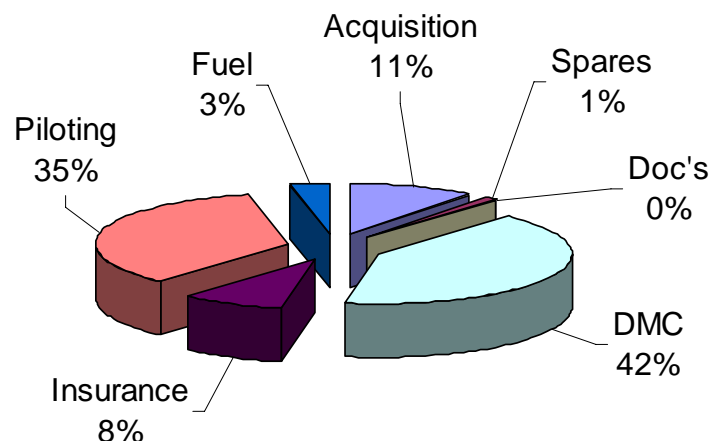
- Life Cycle Cost model for civil operations
- Reflects impact of
 - major technical parameters
 - major categories of customers
 - missions
- Preliminary model consists of three modules:
 - Life Cycle Cost (LCC)
 - rotorcraft acquisition cost
 - Direct Maintenance Cost (DMC)



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Life Cycle Cost module

- Based on the following estimated cost items:
 - rotorcraft acquisition cost
 - cost of spare parts procurement
 - cost of documentation
 - Direct Maintenance Cost
 - insurance cost
 - pilot overall cost
 - fuel cost



Acquisition & Direct Maintenance Cost

- According to major physical parameters, such as
 - the installed power,
 - Max Take-Off Weight,
 - rotor diameter,
 - fuselage size, etc.
- Representative cost breakdown
 - total acquisition cost scaled to represent the published sale prices.

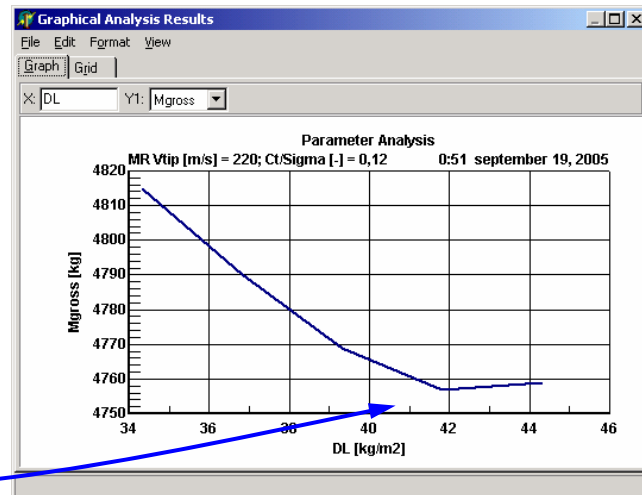
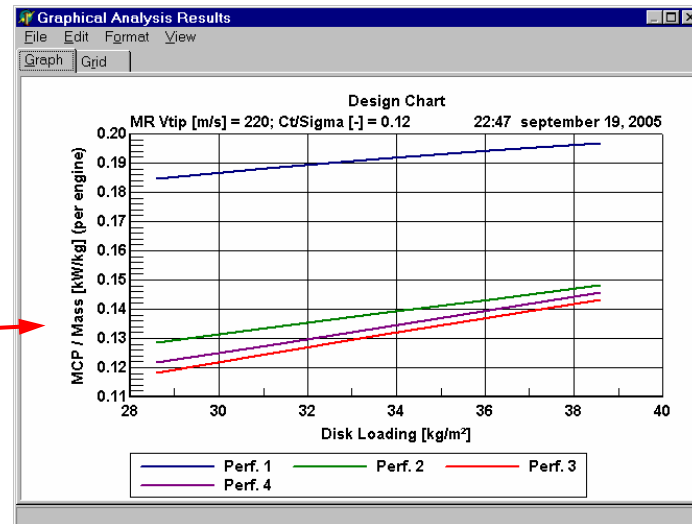


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Demonstration of integrated tool

Design optimisation

- Sensitivity analysis of flight performance requirements to optimise helicopter design
- Helicopter rotor optimisation for lowest mass or lowest cost





Conclusions (1)

VIVACE first iteration **heli MDO results**

- Integrated Pre-design sizing tool:
 - helicopter sizing based on multiple flight and mission performance requirements
 - Life Cycle Cost calculation
- More details: see paper
“Helicopter Life Cycle Cost reduction through pre-design optimisation” by J.F. Boer on VIVACE Forum 1 CD



Conclusions (2)

VIVACE heli MDO next iteration

- Identification of the cost driving parameters and sensitivity analysis
- Extension of the LCC model
- Development of a multidisciplinary design methodology to obtain minimum Life Cycle Cost



Questions

Questions?