“Concept Laboratory”
at LiTH

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EWADE 2007 Samara
Goals

• Concept realisation in smaller scale
• Create means and methods to design and manufacture simpler to more advanced flyable models for concept evaluation and flight testing
• Customers: industry, research institutes and universities
Why?

- Difficult to draw conclusions from just "paperwork"
- Need of a tool for risk assessment
- Evaluation of handling qualities
- C of G at the right place?
- Expensive to manufacture "in-house"
- Complements more expensive testing
How?

- Create a process
- CATIA V5- design tool to interface with customer
- Build on in-house developed sizing program
- Consider scale effects
- Create database for propulsion means
- Create manufacturing processes for different types of models
- Flight testing methodology
Background - Student projects
Manta-2005
Munin-2006
Tools

- Sizing Program in Excel
- Matlab
  - Aerodynamic (Tornado, KTH)
  - Flight Mechanic (DATCOM)
- Catia V5 (design)
- Flight Gear (simulation)
International teamwork
Test of different concepts for vertical take off
• Excel sheet :
  • Geometry :
    • Main Wing: Reference area 0.580 m^2
      Span 1.800 m
      Aspect Ratio 5.600
    Section one  Taper ratio 0.450
      Leading edge sweep 43.340
    Section two  Taper ratio 0.504
      Leading edge sweep 12.253
**Excel sheet:**

- **Balance:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Mass (kg)</th>
<th>x (m)</th>
<th>y (m)</th>
<th>z (m)</th>
<th>Ix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery</td>
<td>0.120</td>
<td>0.510</td>
<td>0</td>
<td></td>
<td>0.061</td>
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<td>Black box</td>
<td>0.000</td>
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<tr>
<td>Canard</td>
<td>0.053</td>
<td>0.125</td>
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<td>0.000</td>
<td>0.007</td>
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<tr>
<td>Conventional landing gear</td>
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<tr>
<td>Canard fin</td>
<td>0.050</td>
<td>0.141</td>
<td>0</td>
<td>0.000</td>
<td>0.005</td>
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<tr>
<td>Duct</td>
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<td>0.613</td>
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<td>0.000</td>
<td>0.226</td>
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<tr>
<td>Engine prop</td>
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<td>0.689</td>
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<td>0.975</td>
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<tr>
<td>Engine mount</td>
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<td>0.600</td>
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<td>0.030</td>
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<tr>
<td>Finelage</td>
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<tr>
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<td>0.900</td>
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<td>0.016</td>
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<td>1.200</td>
<td>0</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Receiver</td>
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<td>0.100</td>
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<td>0.036</td>
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<tr>
<td>Servo 1 right aileron</td>
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<td>0.150</td>
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<tr>
<td>Servo 2 left aileron</td>
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<td>Servo 5 vertical fin lower</td>
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<tr>
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<td>0.099</td>
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<td>Wing inner part</td>
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<td>Wing outer part</td>
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<tr>
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<td>0.076</td>
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</tbody>
</table>

**Payload:**
- gasoline FULL: 0.480 kg, 0.000 kg, 0.000 kg
- gasoline 75%: 0.380 kg, 0.530 kg
- gasoline 50%: 0.240 kg, 0.530 kg
- gasoline 25%: 0.120 kg, 0.530 kg

**Static Margins:**
- Total Empty Weight: 3.679 kg, 0.670 kg, 0.000 kg
- Total at 25% Fuel: 4.119 kg, 0.662 kg, 0.000 kg
- Total at 50% Fuel: 4.419 kg, 0.658 kg, 0.000 kg
- Total at 75% Fuel: 4.668 kg, 0.654 kg, 0.000 kg
- Total at 100% Fuel: 4.859 kg, 0.654 kg, 0.000 kg

2006 – 06 - 13
VTOL Project

- CATIA:
Manufacturing
Manufacturing
Full Scale Version in Composite
(Custumer: Linklab)