The **e-Potential** of Modern Gyroplanes

From the lab to the sky – between research and product development

AERO e-Flight Expo, April 2014

Gerhard T. Meier
Head of Business Development
AutoGyro Group
AutoGyro Company Profile

AutoGyro is the world market leader in development, production and distribution of gyroplanes with more than 1600 sold units worldwide. The company, with locations in Germany and Switzerland, produces gyroplanes in series and currently manufactures five gyroplanes per week.

With distributors in more than 30 countries AutoGyro already operates a global partner network to drives the global gyroplane movement forward and provides best in class support for all the gyroplane customers.

• Pre-incorporated company since 2003 (HTC)
• AutoGyro GmbH founded in 2007 by O. Birkner
• Ca. 100 employees
• Production area in 2010 doubled from 3000m² to 6000m². Expanded in 2013 with additional 5000m² composite production
• 2014: 10 years of gyroplane flying in Germany!
Modern Built Gyroplanes Today

Safe - economical – ecological

- Developed and produced with **new technologies and materials** in lightweight construction
- **Safety** due to autorotation, visibility, speed band, reduced complexity, material usage (carbon fibre/GRP)
- **Stability** and **quiet flight attitude** thanks to the gyro-effect and low contact area in atmospheric turbulence
- Experience **fun** and **freedom** from your proximity to the medium - "air“, and the unique and relatively simple manoeuvrability of a gyroplane
- Incomparably **practical**: Transport on a trailer possible; smallest footprint when storing in a hangar; accessibility for flight preparation
- **Environmentally friendly** due to the low unleaded fuel consumption (eGyro under dev.) and the low impact use of resources of a gyroplane during production (less material, less production “grey” energy)
The e-Gyro Project

World’s first e-powered gyroplane

- Combination of reliable, best-in-class gyroplane technology with proven and successful implemented e-technology from the automotive world
- Replace the single engine piston of the Cavalon with an electric, battery powered engine (80kW/200Nm)
Key Success Factors

Strong technology partnership

- BOSCH General Aviation Technology GmbH provides the full range of the electrical components and the essential development & engineering know how

**Bosch hardware portfolio**

<table>
<thead>
<tr>
<th>Products</th>
<th>Mild hybrid</th>
<th>Full hybrid</th>
<th>Plug-in hybrid</th>
<th>EV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor-generator: 2 product lines</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platform development for various performance levels</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power electronics (inverter, DC/DC, AC/DC)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platform modular for various performance requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Li-Ion battery pack (Robert Bosch Battery Systems)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platform modular for various system requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regenerative braking system</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Based on conventional systems with adjustments for using brake energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle control unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Based on controller from conventional powertrain systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Key Success Factors

Political & financial support

• Niedersachsen Aviation is the network for promotion of the aviation and aerospace industry in Northern Germany.
• As a central contact for the economy, politics and the public, Niedersachsen Aviation develops and accompanies pioneering projects for the aviation and aerospace location of Lower Saxony.

• NBank is the bank for investment and business development in Lower Saxony. It is fully owned by the federal state.
• The NBank plays a key role in financing investments, especially for small and medium sized enterprises (SME), start–up companies and young technology orientated businesses.
Project Goals and Timelines

Feasibility Study – Ready to Fly Q4/2014

- Battery powered flight time of 30’ (with actual cell technology)
- Reduce CO2 emissions
- Reduction of engine noise - Increase acceptance of the airfield residents (flight schools traffic patterns)
- Reduce the oil dependencies and promote new alternative energy resources
- Milestones:
  - Q2/2013 – Projectstart (AERO2013)
  - Q4/2013 – Completed system/product requirement specifications
  - Q1/2014 – Optimized Cavalon fuselage
  - Q3/2014 – Assembled Bosch and battery pack components
  - Q4/2014 – Finalized ground tests
  - Q4/2014 – Ready2Fly
Project Challenges

It’s not «only» an engine replacement!

- Adaption of standard electric automotive technology (e.g. modify controller SW)
- New weight & balance calculations and flight conditions (add. weight ca. 50kg)
- Revise/redefine gyroplane airworthiness requirements (BUT, UK BCAR Section-T, etc.)
- Implementation of an easy to use battery handling and charging system
- New power and temperature management (liquid cooling, high voltage and chemical safety)
- Full avionic integration
- ...
Potential to fly e-Powered Gyroplane’s

- Personal mobility
- Sport and recreational flying
- Flight schools (traffic patterns)
- Light aerial work for police & law enforcement
- Border-/custom control
- Task force operation support for international disaster help
- Environmental monitoring & survey
- Photogrammetry/GIS operations
- Power line and railway monitoring
- Forestry and water protection support
- Agricultural/farmer applications
- ...

AutoGyro Calidus: US Department of Justice - new technology evaluation program

AutoGyro Cavalon: Desert missions – under high temperature and climatic conditions
The multipurpose systems

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>TYPE OF DESIGN APPROVAL</th>
<th>CERTIFICATION BASIS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>Type Approval</td>
<td>BCAR Section T CAP643 (Commercial certificate under development)</td>
<td>This is currently the most used (and referred to) worldwide standard.</td>
</tr>
<tr>
<td>GERMANY</td>
<td>Type Approval</td>
<td>German BUT standard</td>
<td>This was based on the UK Section T.</td>
</tr>
<tr>
<td>USA</td>
<td>Experimental (actual)</td>
<td>FAA primary category (under development)</td>
<td>New FAA primary category gyroplane standard will be released in summer 2014</td>
</tr>
<tr>
<td>OTHERS (China)</td>
<td>Most either refer to Section T, or have a similar document</td>
<td><strong>ASTM F2449-09</strong> (Standard Specification for Manufacturer Quality Assurance Program for Light Sport Gyroplane Aircraft) respectively <strong>EN 9100</strong> <strong>ASTM F2352-11</strong></td>
<td>Any local approval is based on either the Section T or BUT approval, depending on local CAA requirements. Compliance documents were based on the UK section T submission, and created by RSUK</td>
</tr>
</tbody>
</table>

China refers to the ASTM standard issued by the FAA – but this is not used in USA.
AutoGyro – multiple (mission spec.) options

Cavalon-Cockpit equipped with Garmin 695

Calidus-Cockpit equipped with Dynon Skyview 10"

ROTAX 912 and 914 turbo charged

E-Engine powered (Bosch SMG 180) under development
Get ready to shape the future of mobility - now!

AutoGyro GmbH
Dornierstrasse 14
D-31137 Hildesheim
Tel. +49 (0) 5121 880 56 00
E-mail: info@auto-gyro.com