

# Simultaneous Motor Angle and Current Sensing Using Modified dynCOBROS

## Application of the COBROS Method to an Axial Flux Synchronous Machine Under Different Load Conditions

### Graduate



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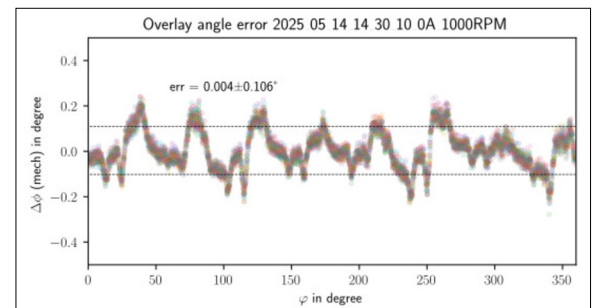
**Introduction:** Controlling synchronous machines, such as Permanent Magnet Synchronous Motors (PMSM), requires precise angle and phase current measurement. CTS maglab has proposed and patented a new approach for the angle determination, called COBROS, which has proven effective under constant load conditions in various past research projects, where static and dynamic (dynCOBROS) variants were investigated. In this work, a modified implementation of the algorithm is presented, which reduces computational effort and incorporates a current measurement. Furthermore, a new motor testbench is employed to test and optimise the algorithm under various load conditions.

**Approach:** COBROS places multiple magnetic field sensors within the stray field of the machine and applies a dimensionality reduction method and a Kalman filter to determine the angle from the measurement data. When used with a PMSM, the COBROS system works similarly to a traditional magnetic encoder; however, instead of using an external magnet on the rotor, it uses the field of the magnets inside the rotor. The required amount of Hall elements depends on various factors, including the machine characteristics, the desired COBROS output and feasible sensor mounting positions. In the present setup, the measurement also contain a strong stator field component. This not only affects the angle estimation, but also enables simultaneous stator current sensing.

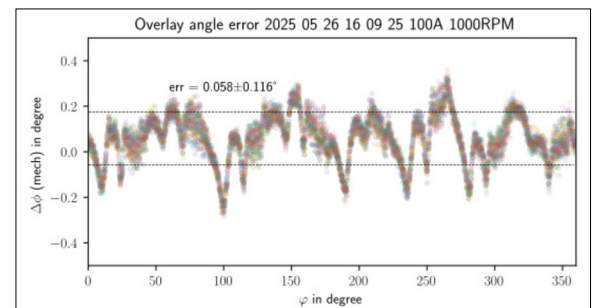
**Result:** By separating the fields, the COBROS algorithm could be applied to multiple different datasets collected under different load conditions. Although some dimensions have to be discarded to get rid of the stator field component, the angle determination remained sufficiently accurate and

suitable for motor control. Moreover, applying the same method to the remaining field data confirmed that current measurement is feasible using similar algorithms. While the accuracy of the current estimation is limited due to the sensor placement optimised for angle estimation in the test machine, COBROS offers a promising, new path towards simultaneous angle and current sensing.

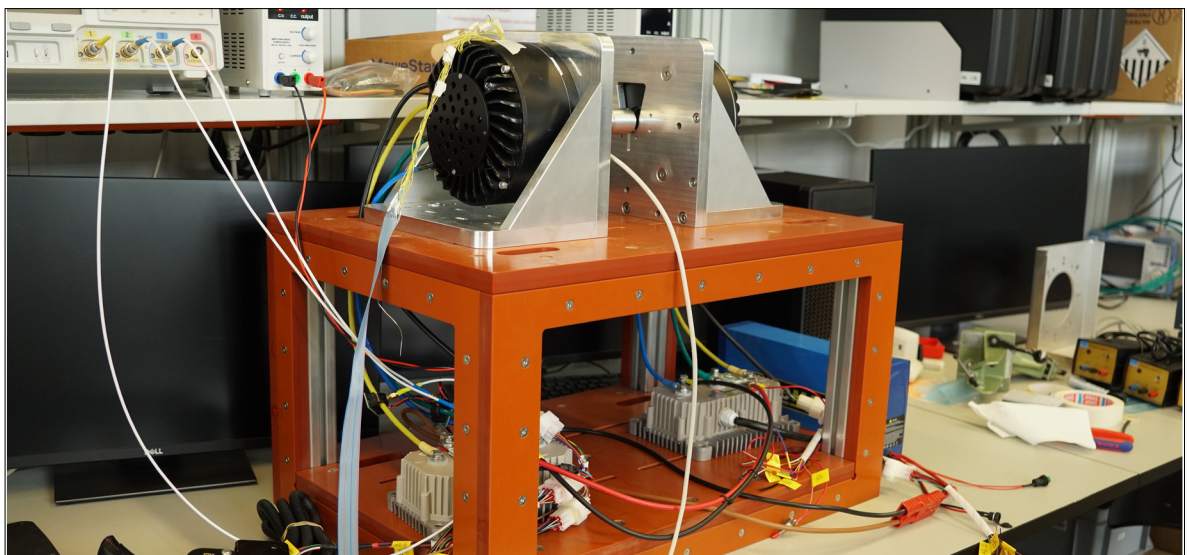
**Overlay of angle errors from several subsequent turns at no-load condition.**  
Own presentation



**Overlay of angle errors from several subsequent turns at 100 A phase current.**  
Own presentation



**Motor testbench with DUT and load machine for data acquisition.**  
Own presentation



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