# Hybrid Control of a BLDC Motor

## Target group
This project proposal addresses primarily students at the 9th and 10th Semester.

## Scope
Currently, one of the hottest research topics in the control community is hybrid systems on various forms. Hybrid systems is a class of dynamical systems that exhibit both continuous (linear or nonlinear) dynamics and discrete events, for instance in the form of abrupt changes in describing dynamics (saturations, switching behavior) or external events (e.g., switching control). In the power electronic community it is well known that three phase Brushless Direct Current (BLDC) motors are often controlled in a mode where the structure of the dynamics changes during operation. Therefore, it might be possible to benefit from hybrid systems theory in the design and analysis of control schemes for BLDC motors.

## Objectives
Basicallly, the objective is to develop a hybrid control scheme for the BLDC motor. More specifically the following objectives could be included.

1. Develop a hybrid observer and control based on a previous developed model of the BLDC motor.
2. Verify the developed control scheme on a real test system (provided by Grundfos).

## Description
The BLDC motor is a compact and mechanical robust electrical motor with high efficiency. Thus, it is used in many applications; for example, Grundfos uses BLDC motors in submersible pump applications.

In general a BLDC motor is unstable and can therefore not run without some sort of control. The actuator used for controlling the BLDC motor is, in this case, chosen to be a three phase inverter as shown in Figure 1. The control scheme traditional using in BLDC motors can create torque ripple. It is the task of this project is to develop a control scheme, which minimizes the torque ripple. It is believed that theory of hybrid control might be used for this purpose.

![Three phase inverter and BLDC motor](image)

**Figure 1**: Sketch of the electrical circuit of a BLDC motor and the electronic drive.

The project will be made in cooperating with Grundfos. Grundfos has a long tradition of using electrical machines, and also, describing such dynamic systems mathematically. Therefore, Grundfos will be able to assist by with respect to supervision and providing the necessary equipment.
The project will, among others, include the following topics.

- Hybrid systems (modelling, analysis, control)
- Electrical machinery (BLDC motors, and electrical machinery in general)
- Observer design
- Advanced control.

Resources
An actual test system will be provided either at Grundfos in Bjerringbro or at Aalborg University.

Contacts

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