FACULTY OF ENGINEERING AND ARCHITECTURE

ELECTRICAL ENERGY LAB

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ACTIVE FAULT COMPENSATION BASED ON ONLINE RECONFIGURATION OF MODULAR AXIAL FLUX DRIVES

Abstract

Sustainable energy applications require electrical machines with high reliability in extreme circumstances. Due to their high efficiency, low weight, numerous degrees of freedom and inherent redundancy, modular axial flux permanent magnet synchronous machines (AFPMSMs) are perfectly suitable for this purpose. In this project, it will be investigated how the additional degrees of freedom of modular AFPMSMs can be used efficiently, in order to increase the reliability of these drives, i.e. to keep them operating as well as possible in case of defects. The main focus will be on the online reconfiguration of the stator winding connections and current waveforms of the modules.

Methodology

Benchmark ☑

- Torque control study for different stator winding configurations of **healthy modular AFPMSM**
- Hardware realization of **online stator winding reconfiguration**
- Real-time determination of optimal stator winding topology

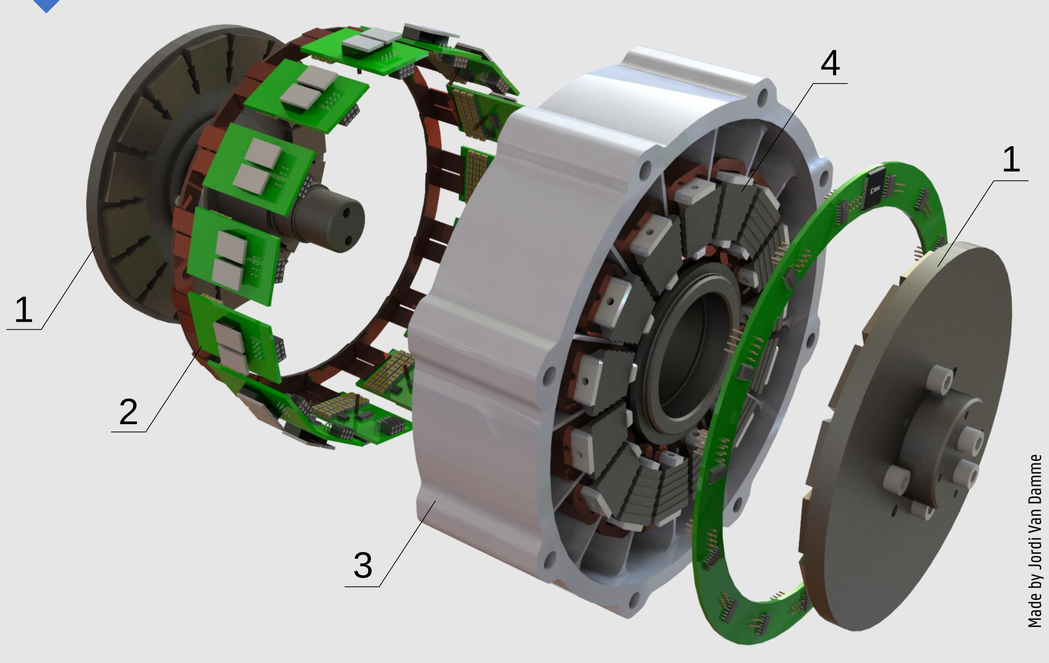
Fault detection ☐

- Extension of **fault detection and classification** algorithms (open- and short-circuit faults, permanent magnet demagnetization and rotor eccentricity) through intelligent use of extra degrees of freedom of modular AFPMSM

  e.g.: distinct frequency for all converters to identify fault location

Active fault compensation ☐

- Theoretical study of required waveforms to **counteract effect of certain fault**
- Mapping of faulty machine to virtual healthy machine
  → benchmark can be reused



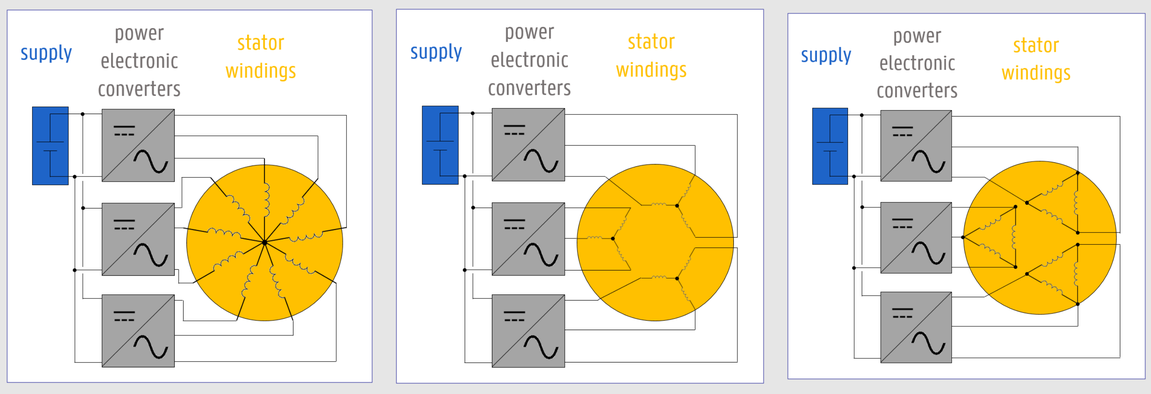
Made by Jordi Van Damme

Modular AFPMSM: (1) rotor disc with permanent magnets, (2) power electronics per stator module, (3) motor housing and heatsink, (4) stator core element with concentrated winding.

Optimal stator winding arrangement

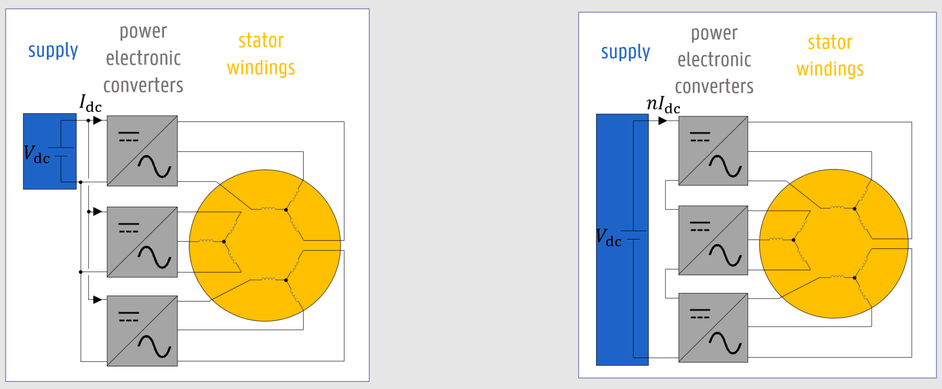
E.g. is it more efficient to connect the stator windings in:

(a) one single star, (b) multiple stars, (c) multiple deltas?



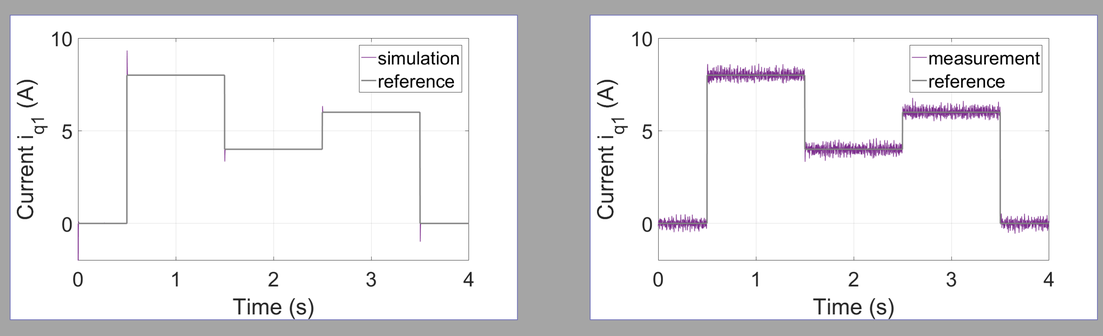
E.g. must the modules be connected to the DC bus in:

(a) parallel, (b) series?



Preliminary results

Benchmark: 15-phase PI-control when stator windings are connected in 5 stars.



Simulation Experiment

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