Excitation Boosting (EB) Functionality for Enhanced FRT-Capability with a new Brushless Exciter

Jonas Kristiansen Nøland[1,2] and Urban Lundin[1]

[1] Department of Engineering Sciences, Division of Electricity, Uppsala University, Uppsala 751 21, Sweden (e-mail: Jonas.Noland@Angstrom.uu.se)
[2] Faculty of Technology and Maritime Sciences, Department of Engineering, University College of Southeast Norway, 3184 Borre, Norway (e-mail: Jonas.Noland@hbv.no)

Abstract

Early transient stability problems were mitigated by
- increasing generator's inertia
- reinforcing the transmission system

Modifications in the excitation system has been shown to be a cost-effective alternative. Patents exists on the commercial market, such as
- GE GENERREX employing additional current transformers
- GE EXCITATION BOOSTER employing additonal ultracapacitor

However, a new carbon dust free high-speed response brushless exciter includes excitation boosting (EB) functionality, without the need of additional components and circuitry, contrary to the static exciter. Elimination of brushes and slips rings reduces regular maintenance, lower downtime and lower risk of brush-fire; yielding a reduction in the predicted cost-of-energy.

A new era for large brushless synchronous machines is initiated. Contrary to common knowledge, the new brushless exciter have multiple advantages beyond the conventional static system.

GE's new static excitation booster

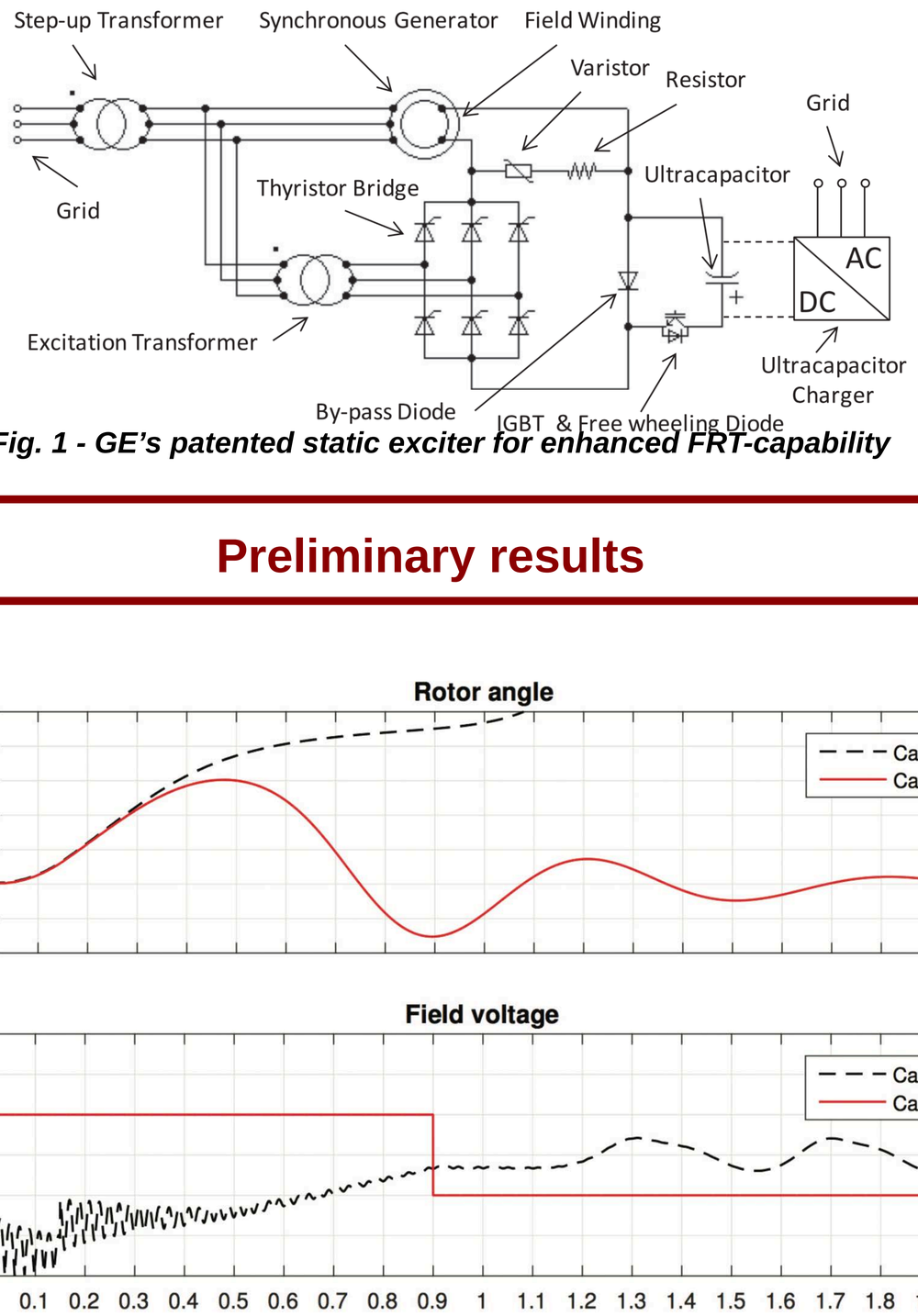


Fig. 1 - GE's patented static exciter for enhanced FRT-capability

Preliminary results

Fig. 2 - Fault Ride-Through excitation boosting response of high-speed brushless exciter (case 4) compared with conventional static exciter (case 3)

Review of state-of-the-art

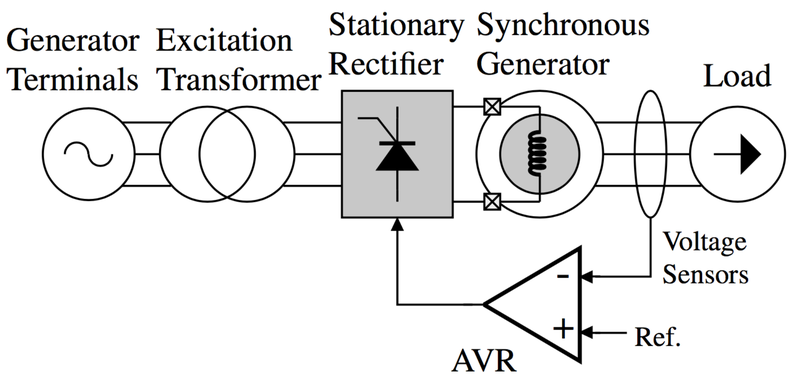


Fig. 3 - Conventional static exciter

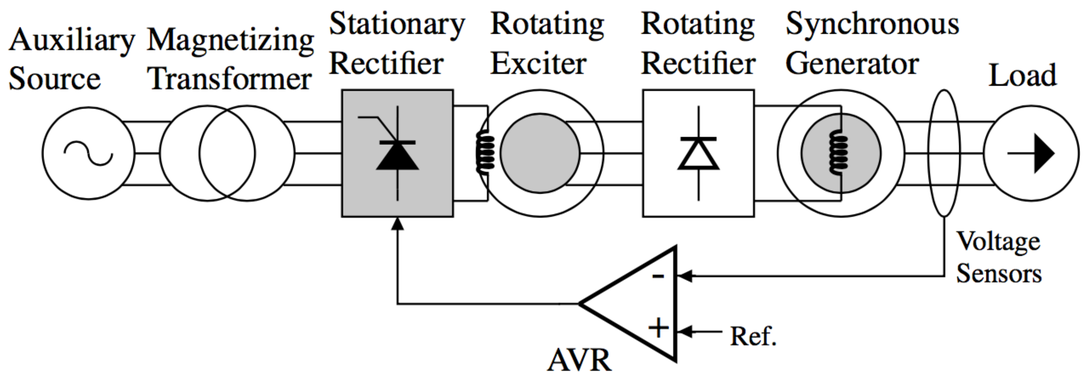


Fig. 4 - Conventional brushless rotating exciter

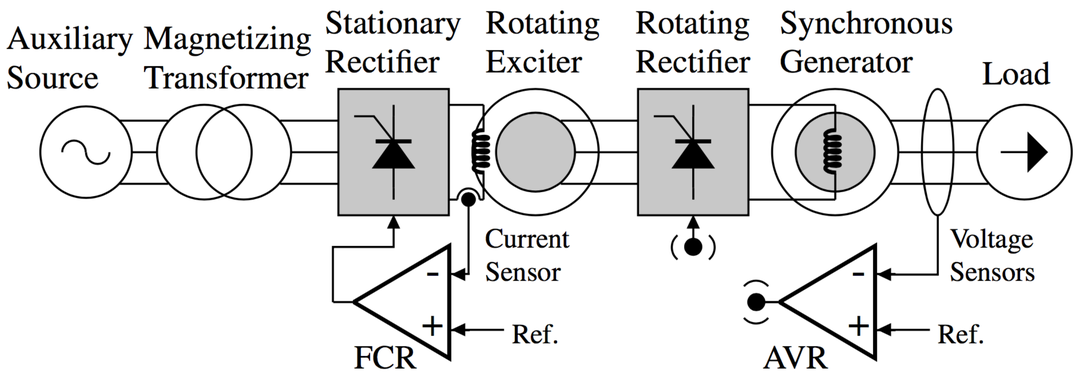


Fig. 5 - High-speed response brushless rotating exciter (Voith)

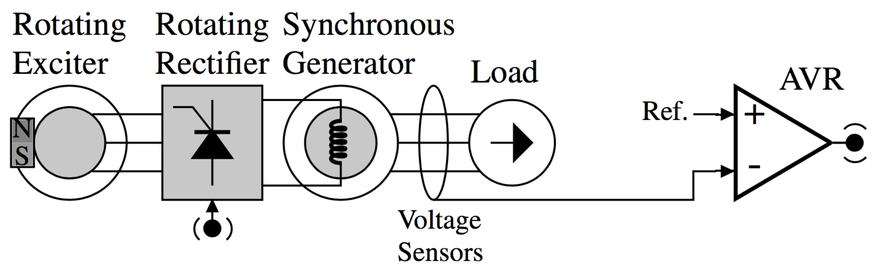
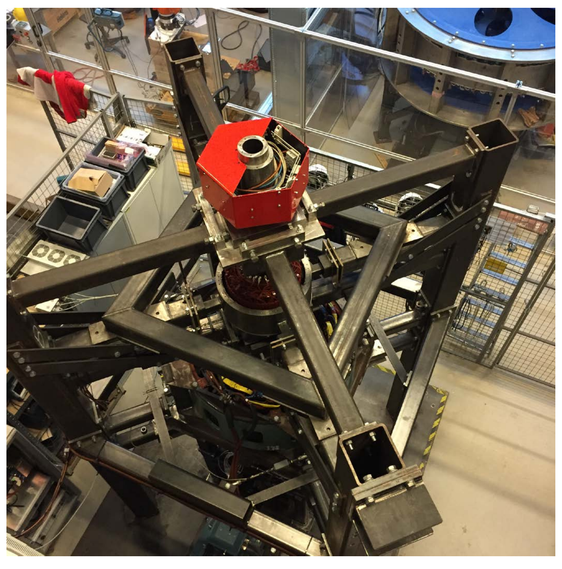


Fig. 6 - High-speed response brushless rotating exciter (UU)



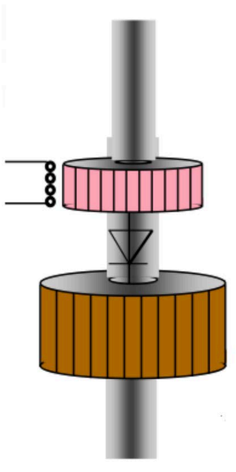


Fig. 7 - In-house experimental platform at Uppsala University

Selected Publications

[1] *Design and characterization of a rotating brushless outer pole PM exciter for a synchronous generator,* **IEEE Transactions on Industry Applications**, vol. 53, no. 3, 2017.
[2] *Comparison of Thyristor-Controlled Rectification Topologies for a Six-Phase Rotating Brushless Permanent Magnet Exciter,* **IEEE Transactions on Energy Conversion**, 2016.
[3] *Testing of active rectification topologies on a six-phase rotating brushless outer pole PM exciter,* **IEEE Transactions on Energy Conversion**, 2017, 2nd review.
[4] *Comparison of Thyristor Rectifer Configurations for a Six-Phase Rotating Brushless Outer Pole PM Exciter,* **IEEE Transactions on Industrial Electronics**, 2017, 2nd review.
[5] *Failure-Modes of a Thyristor-Controlled Six-Phase Rotating Brushless Exciter with 12-Pulse Hybrid-Mode Operation,* **IEEE Transactions on Industrial Electronics**, 2017, 1st review.