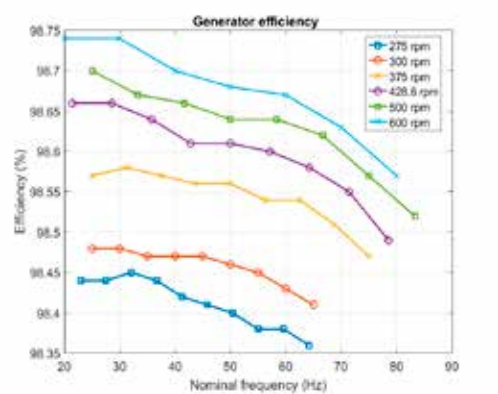
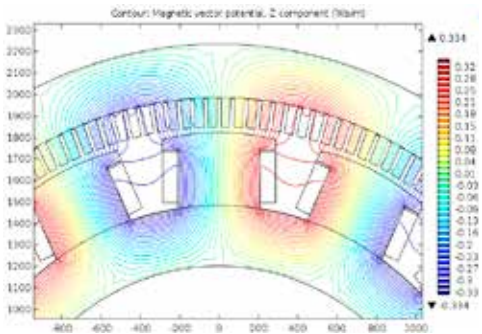
Background

The power system is experiencing an increasing share of electric power production that comes from intermittent power sources like wind and solar. Increased pressure is put on controllable power sources like hydropower to deal with fluctuations in the output of electric power production.

Generators used in hydropower plants today are not designed and optimized for frequent changes in active power production. The main purpose of this work is to develop optimum synchronous generator designs where the speed of rotation and electrical frequency is allowed to vary within given intervals.

Results indicates that the highest efficiency is achieved at low nominal frequencies, while generator weight is reduced substantially at higher nominal frequencies. Cost optimization where both losses and use of materials are taken into account indicates that a nominal frequency around 50 Hz will achieve the lowest total cost. There are also cost benefits associated with increasing the maximum values of the synchronous reactance, but this does also cause several possible design issues that will have to be resolved.





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2014 - 2018

Design of variable speed generators for hydropower applications

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