# Turbocharger Electrification - System and Control Strategy Evaluation

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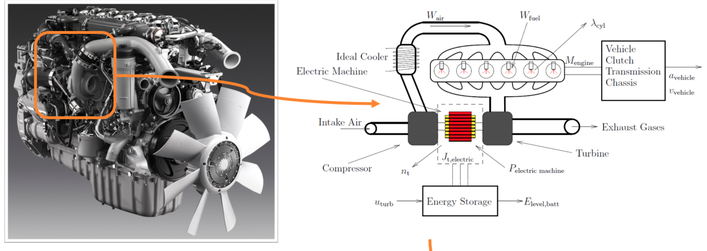
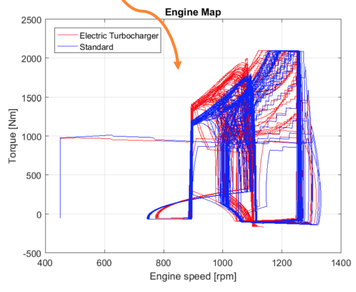
**Introduction** Emission regulations are constantly putting pressure on the vehicle industry, forcing the development and research to put lots of effort and time into reducing the emissions released by the vehicles. The users of the vehicles however, might have higher interest in the fuel consumption than the amount of released emissions. To cope with the emission regulations today, variable geometry turbine and exhaust gas recirculation are implemented, to be able to both control the power consumed by the turbine, and the amount of exhaust gas being recirculated. The electric turbocharger might be one more key component when trying to reduce both the emissions released from the vehicle, and the fuel consumption.

**Investigated System**




**Why** The project aim is to investigate the possible benefits with electrified turbocharger. Study the system containing electric turbocharger, and possibly other electric machines, which might be needed to extract the needed amount of electric energy.

**What** The turbocharger uses power from the exhaust gasses to compress air into the intake manifold. By introducing an electric machine on the turbocharger shaft, the intake manifold pressure can be increased even when there is no power available in the exhaust gasses. The outcome of the project is deeper knowledge and understanding of the system containing an electric turbocharger.

**How** By using high fidelity simulation models and closed loop control strategies (TruckBenchmark, containing LiU Diesel engine model), the system behavior is analyzed [1].

**Status** An optimal control ready model of a diesel engine is developed [2].

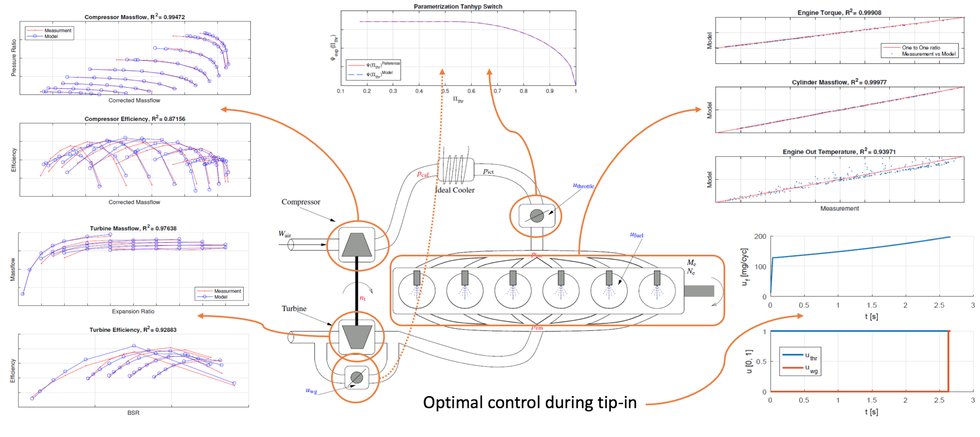
**Next Step** The continuously differentiable model will be used in situations where optimal control of the electric turbocharger machine is of interest, for example during gear changes or during transients. The future vision is to develop control strategies, based on the optimal control results, and implement these to evaluate the real time performance of such controller.



**Results & References**

*[1] Kristoffer Ekberg, and Lars Eriksson (2017). Improving Fuel Economy and Acceleration by Electric Turbocharger Control for Heavy Duty Long Haulage. IFAC World Congress. Toulouse, France.*

*[2] Kristoffer Ekberg, Viktor Leek and Lars Eriksson (2017). Optimal Control of Wastegate Throttle and Fuel Injection for a Heavy-Duty Turbocharged Diesel Engine During Tip-In. 58th Conference on Simulation and Modelling (SIMS 58). Reykjavik, Iceland.*

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