**Aerodynamic and structural optimization of a turbocharger compressor impeller using modeFRONTIER.**

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Abstract

This paper presents a design approach of a turbo charger radial compressor for commercial diesel applications. The primary goal of the design is to maximize total to static efficiency at a specific mass flow rate and pressure ratio, while also providing useful performance at off design conditions (map width). The design is also constrained by mechanical limitations for maximum stress and minimum frequency response. The design of the impeller uses modeFRONTIER as the optimization driver, Concepts NREC AxCent and ProEngineer as the geometry engines, and Concepts NREC PBCFD and Ansys Workbench as aerodynamic and structural analysis tools, respectively. The optimization is set up in two stages, first an aerodynamic optimization that varies impeller blade shape and hub and shroud contours, and second a structural optimization that varies back wall contours and blade fillet radii. The resulting designs are then evaluated on a gas stand at the BorgWarner Tech Center in Arden, NC. Results show that substantial peak efficiency gains over conventional designs can be achieved. However, in part due to inaccuracies in CFD predictions near the surge line of the compressor, map width expansion remains a challenging task for this methodology.