

# High Performance Industrial Fan Optimization

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## ABSTRACT

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**Abstract.** *In the industrial environment, axial air flow fans are high volume flow equipment and therefore high energy consumers. The energy consumption is directly affected by the efficiency of the fan. Efficiency improvement of axial fans is therefore of great importance and is traditionally achieved by using large, time consuming experimental wind tunnels [1]. These gave limited insight into how the air interacts with the fan blades limiting the potential improvements. A modern tool to model and improve the efficiency is computational fluid dynamics (CFD) as presented here. The axial fan blade geometry is represented by parametric analytical equations, the latter being a function of the most important blade profile variables used in the fan industry. The CFD code used for the incompressible, viscous, turbulent flow modeling is Elemental. Spalart Allmaras has been selected as the turbulence model [2] which utilizes Bezier curve approximations. The experimentally verified CFD fan model is utilized by the optimization module of the Elemental code. The fan efficiency (objective function) is maximized by finding the optimum geometry of the blade profile. The optimization technology, a spherical quadratic steepest descent (SQSD) method [3], applies the steepest descent method to successive spherical quadratic approximations of the objective function. The optimized geometry is then used in the manufacturing of the blades of a fan, where the optimized performance is experimentally verified and compared to the CFD modeled results.*

## References

- [1] R.A Wallis, *Axial Flow Fans and Ducts*, 1983.
- [2] F.N. le Roux, *The CFD Simulation Of An Axial Flow Fan*, 2010.
- [3] J.A Snyman, *Practical Mathematical Optimization*, 2005.