# Adjoint based Shape Optimization of a Transonic Axial Compressor

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## Abstract

This study introduces an automated, Python-based workflow that integrates multiple computational tools for transonic axial compressor shape optimization. The methodology begins with an in-house code for flowpath and meanline design. Next, geometry parametrization is performed using ParaBlade, which enables CAD-based parametrization. The parametrized geometry is then meshed using AutoGrid or Turbogrid. The entire pre-processing chain is automated through Python scripts. The computational mesh is then used as input for SU2, where shape optimization is performed using the adjoint method and mesh deformation techniques. This gradient-based approach, combined with the adjoint method, significantly reduces the computational cost of sensitivity analysis compared to traditional finite-difference methods. The automated framework efficiently explores the design space while maintaining the geometric and aerodynamic constraints typical of transonic compressor applications. Integrating these tools demonstrates a robust workflow for modern turbomachinery design where shape optimization can be incorporated into the design process to enhance aerodynamic performance while reducing computational expense.

## Keywords

Shape Optimization, Transonic Compressor, Turbomachinery, Adjoint-based Optimization.