



Part 2. AxSTREAM Interactive Workshop on Turbomachinery Design and Optimization

Introduction

The objective of the workshop is to provide participants with a practical understanding for the rapid multidisciplinary design optimization of flow paths for turbomachinery equipment using AxSTREAM.

This is an interactive, hands-on workshop where the participants can choose a particular track based on their specific interests:

- Axial and radial turbomachinery (comprehensive overview)
- Axial turbine
- Axial compressor
- Centrifugal compressor
- Radial turbine
- Retrofitting and performance upgrades

By the end of the course, the attendees will be able to design and optimize a complete flow path design from basic boundary condition data.

This leads to the design of 3-dimensional airfoils that many stacked and/or leaned for optimum performance. Finally, a 3-D FEA analysis and 3-D CFD flow analysis can be performed prior to the generation of necessary data for manufacture or input files for more sophisticated CFD analysis.

Course Scope

- Theory of turbomachinery design from conceptual to reality, and the role of AxSTREAM in the design process.
- Features and major design parameters of axial and radial turbomachinery.
- How to use AxSTREAM to design an optimized flow path from preliminary design to generation of 3D blade profiles, for both original design or redesign of existing equipment.
- The effective use of multidisciplinary analysis.
- Participants will create original flow path designs for axial compressor, axial turbine, centrifugal compressor and radial turbine.



Who should attend

Engineers involved in the design or retrofitting of flow paths for turbines, compressors, turbochargers, fans, blowers, turbopumps;

Anyone interested in getting the most out of the power of AxSTREAM.

Outline and Schedule

Day 1

Part I. Introduction: Fundamentals of Turbomachinery Flow Path Design

- Engine Cycle
- Flowpath Design
- Detailed Design of Turbomachinery
- AxSTREAM - Features, Functions & Applications

Part II. Design and Analysis Process (based on Axial Turbine)

Preliminary Design – Flowpath

- *Design concept; selection of relevant cycle data*
- *Creation of new AxSTREAM project, data input, loss models,*
- *Initial flowpath design, definition of stages, velocity diagrams, initial performance estimate*

Analysis and Optimization in 1-D

- Design space, design restraints, performance criteria
- Meanline design
- AxPLAN - Stage & overall performance optimization

Turbine Map Generation

- AxMAP - map generation from 1-D data
- Parameter selection & adjustment
- Map presentation

Analysis and Optimization in 2-D

- Vortex blade design and optimization
- Performance considerations

Turbine Blade Profiling

- Blade profile construction & control
- Surface distributions of pressure, velocity, etc



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- Performance benefits & optimization

Day 2

Turbine Blade Stacking and Design Validation

- Blade stacking capabilities
- Benefits to structural integrity & performance
- 3D FEA solver
- 3D Flow solver

PART III. AxSTREAM - Design & Analysis of an Axial Compressor

Preliminary Design – Flowpath

Analysis and Optimization in 1-D

Analysis and Optimization in 2-D

Compressor Map Generation

Compressor Blade Profiling & Stacking

Day 3

Part IV. Design and Analysis of Radial Turbine.

Preliminary Design (Cylinder)

Analysis and Optimization in 1-D

Analysis and Optimization in 2-D

Radial Turbine Blade Design

Part V. AxSTREAM - Design & Analysis of a Centrifugal Compressor

Preliminary Design (Cylinder)

- Use of the code will be demonstrated for design of outward-flow radial machines
- Comparisons will be made with axial counterpart

Analysis and Optimization in 1-D

Centrifugal Compressor Blade Design

PART VI. Summary & Re-cap

- AxSTREAM in the real world; professional & student versions
- Questions & Discussion



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PART VII. Special Topics

During day 3 and concurrent with Parts IV and V, the instructor conducts special topical Break-out sessions to educate students on how to utilize AxSTREAM in specialized ways. Example would be retrofitting and upgrading steam turbines during overhauls.