Pump Inducer Design with CFturbo®

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Online CFTurbo® Demo
CFturbo® company – Overview

• **CFturbo® Software & Engineering GmbH**
  German company was established in September 2008

• **Headquarter in Dresden**, Munich office

• Distributors for key markets in Europe, China, India, Korea, UK, USA and Russia >> **Axis Engineering, St. Petersburg**

• 20 employees

• Full engineering supplier for Conceptual **Turbomachinery Design** Software, related CAE-consulting, CAD-services and prototyping
CFturbo® company – Business Areas

**CFturbo® Software & Engineering GmbH**

**CFturbo® Software**
- Conceptual Design Software
- Automated Workflows

**Engineering**
- Turbomachinery Design
- CFD/FEA Simulation
- Optimization

**CAD & Prototyping**
- 3D-CAD
- Prototyping
- Testing
CFturbo® Software

- **CFturbo®** is a modern, powerful and very user-friendly software tool for **Conceptual Turbomachinery Design**

  **Impeller types**  
  Radial & mixed-flow, Axial

  **Blade shapes**  
  3D, 2D, Circular, Ruled surface, Radial elements, Helical, ...

- On the market since 2005
- More than 120 active clients around the globe
CFTurbo® Software – Examples Pumps

Axial  Mixed-flow  Radial (with inducer)
CFturbo® Software – Example Radial Pump Stage with Return Channel
CFturbo® Software – Examples Compressors & Turbines

- Compressor with ruled surface blades
- Turbine (VTG) with radial element blades
- Axial turbine (rotor & stator)
Pump Inducer Design with CFturbo®

CFturbo® Software – How it works

Machine design point
m, H/Δp, RPM,
Fluid properties,
Inlet conditions

Fundamental fluid equations
Bernoulli, Euler equation,
Mass, Momentum, Energy
conservation,
Velocity triangles, …

Empirical functions
Publicly available knowledge,
In-house know-how;
Can be customized...

Reference geometry
from CFturbo

Existing, external
geometry

New / improved
3D geometry
Development process for Turbomachinery components

1. **Design**
   - **Conceptual Design**
     - CFturbo®
   - **Meshing**
     - ANSA, AutoGrid, ANSYS, Pointwise, TurboGrid, ...

2. **Simulation & Validation**
   - **CFD/FEA Simulation**
     - STAR-CCM+, ANSYS-CFX, FINE/Turbo, PumpLinx, ...
   - **Optimization**
     - Interactive or automatic

3. **Product**
   - **Experiments**
     - Rapid Prototyping, Testing, Validation
   - **3D-CAD**
     - CATIA, Creo, Inventor, NX, SolidWorks, SpaceClaim, ...

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## Interfaces to important CFD-codes for Turbomachinery simulation

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*Create seamless interfaces to allow automated workflows and optimization*
Example: Interface CFturbo® – PumpLinx

PumpLinx

• Automated binary-tree mesh
• Cartesian mesh based on closed surface models (STL)
• Very fast CFD-Solver
• Direct simulation start from CFturbo
Example: Rocket engine pump with inducer (PumpLinx)

Velocity

Static Pressure

662 m³/h

120 m/s

0 m/s

1.2e+07 Pa

0 Pa

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Example: Vapor fraction area simulation (PumpLinx)

400 m³/h

600 m³/h

700 m³/h

800 m³/h
Example: Performance curves with cavitation modeling (PumpLinx)

Total pressure differences were computed between inducer inlet and volute outlet.

WITHOUT CAVITATION

WITH CAVITATION

Total pressure difference [bar]

Flow rate [m^3/h]

TRWC_500k_3bar
TRWC_1Mio_1.77bar
TRWC_1Mio_3bar
STNC_1Mio_1.77bar
STNC_1Mio_3bar
STNC_500k_3bar_LOX
STNC_2Mio_1.77bar
STNC_2Mio_3bar

Example: Performance curves with cavitation modeling (PumpLinx)
Online CFturbo® Demo – Conceptual Design of an Inducer Pump

**Design Point Definition**

\[ \Delta p = 185 \text{ bar} \]
\[ Q = 200 \text{ m}^3/\text{h} \]
\[ n = 30 000 \text{ rpm} \]

Fluid: Water