KEY CONCEPTS IN ORC TURBINE FLUID-DYNAMIC DESIGN

Matteo Pini[1], Salvatore Vitale[1], Antonio Rubino[1]

Antonio Ghidoni[2]

[1]Delft University of Technology, Faculty of Aerospace Engineering,
Delft, The Netherlands
m.pini@tudelft.nl (E-mail)

[2]Universita' degli Studi di Brescia, Department of Mechanical Engineering,
Brescia, Italy
a.ghidoni@unibs.it (E-mail)

Organic Rankine Cycles (ORC) power systems are a widespread technology for the conversion of thermal energy sources in the small-to-medium power range. The realization of successful ORC power systems demands for highly efficient turbo-expanders. In order to meet this goal, a sound strategy for the fluid dynamic design of the expander design is necessary. Novel turbine configuration concepts, a dedicated preliminary design optimization, and the design of blade profiles through advanced methodologies are all key components of this strategy.

The aim of this tutorial is to show designers and researchers how to accomplish the optimal fluid-dynamic design of ORC turbines. To support the demonstration, the tutorial will make use of four different tools: (i) a meanline design code (zTurbo) that enables the design of new ORC turbine concepts (ii) a knowledge-based blade modeler (TBM) that allows to create CAD models of axial and radial turbine cascades (iii) a fully automatic hybrid mesh generation tool (UMG3) to construct high-quality anisotropic hybrid meshes, and (iv) the SU2 open-source NICFD (non-ideal compressible fluid dynamics) code, which allows to perform the fluid-dynamic analysis of the resulting turbine configurations through steady and unsteady compressible turbulent simulations in combination with arbitrarily complex thermo-physical models of the working fluid.