Hochschule Konstanz
Fakultät Maschinenbau

ThermoFluidStream (TFS)

Developments at the HTWG Konstanz

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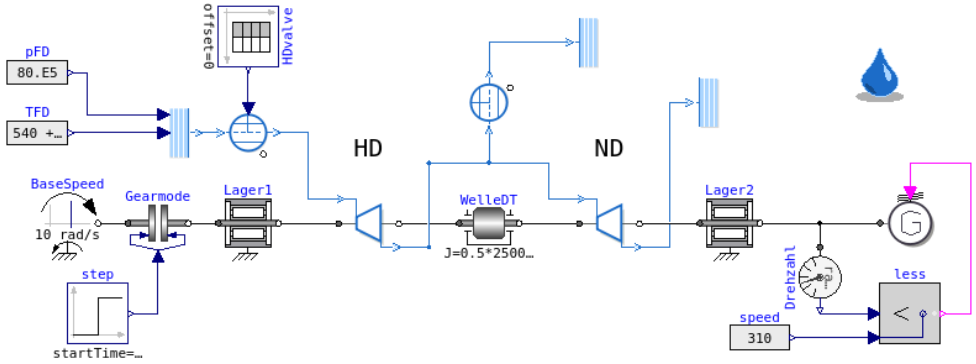
HTWG Konstanz

Background

Who are we an how do we use Modelica and ThermoFluidStream

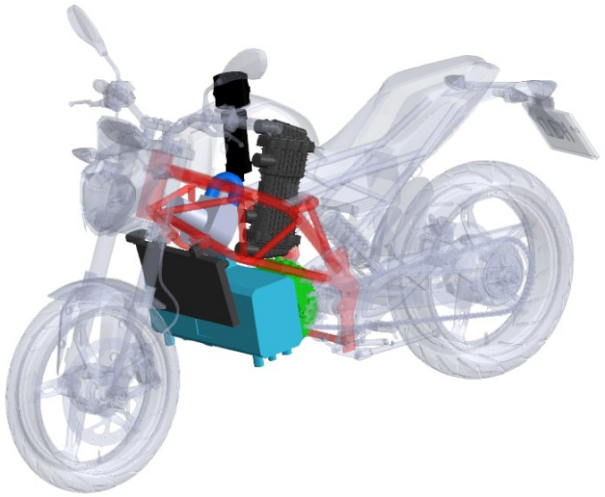
- The HTWG Konstanz is a University of Applied Sciences in the very south of Germany
- We have a school of Mechanical Engineering where we offer Bachelor and Master degree courses
- Within the Bachelor's degree program, we offer courses of specialization, one of which is about energy systems and system simulations i.e. Modelica
- Subjects are ranging from simple models to complex systems like heat pumps, steam turbines and fuel cell systems
- We use the standard library as well as TFS and develop our own library, mainly for the purpose of the lectures

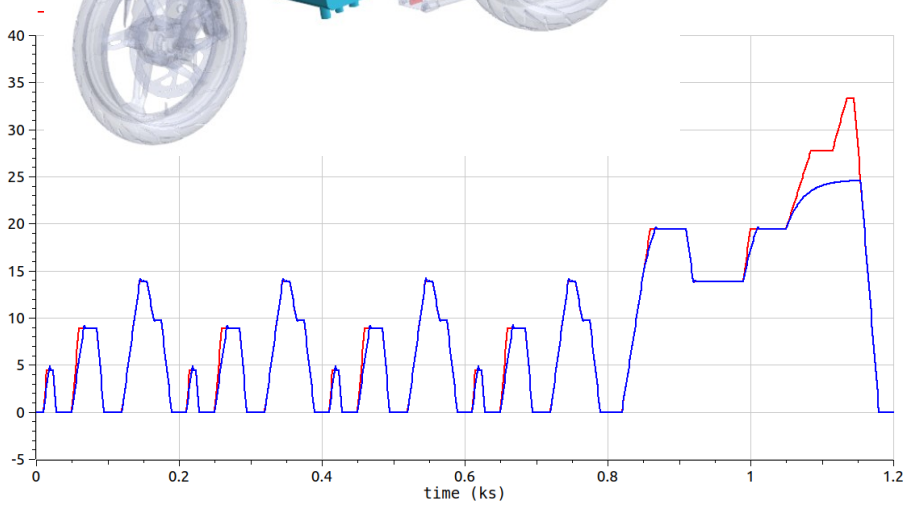


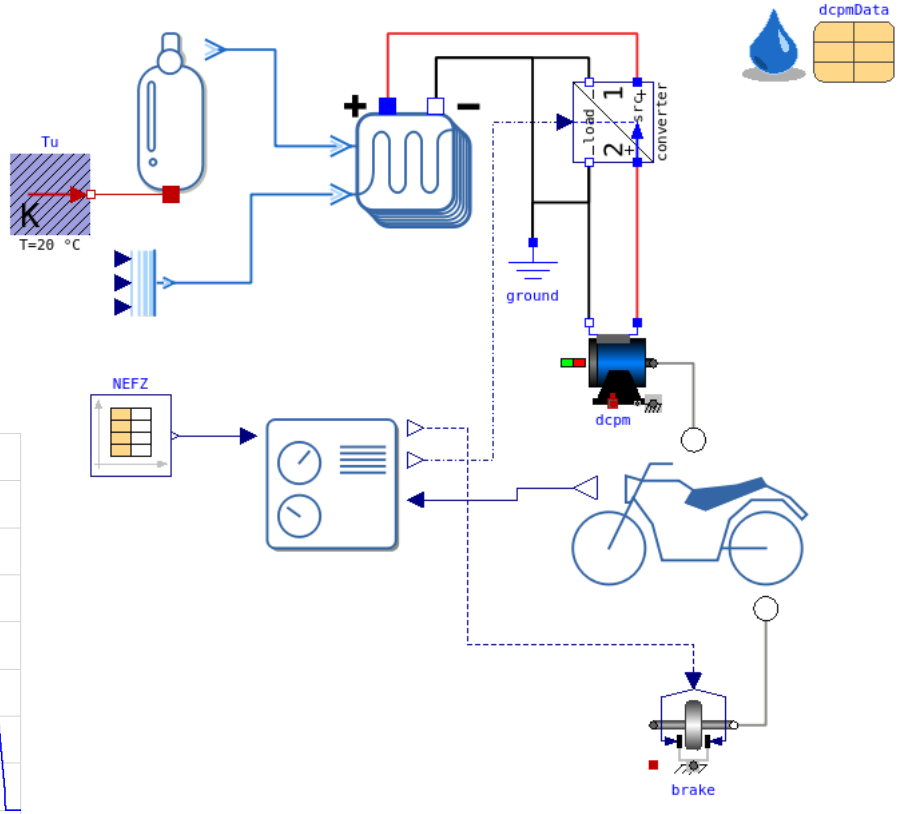
Typical cases

Fuel Cell System

- In 2019 we started to develop a fuel cell based motorbike and as a side product, we modelled this in Modelica
- Now a part of the model is used in the lectures





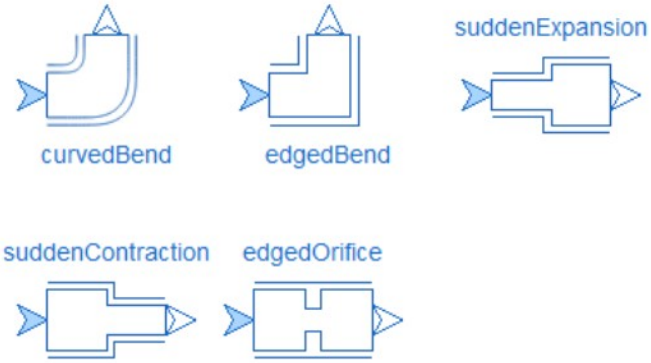


Pipe models

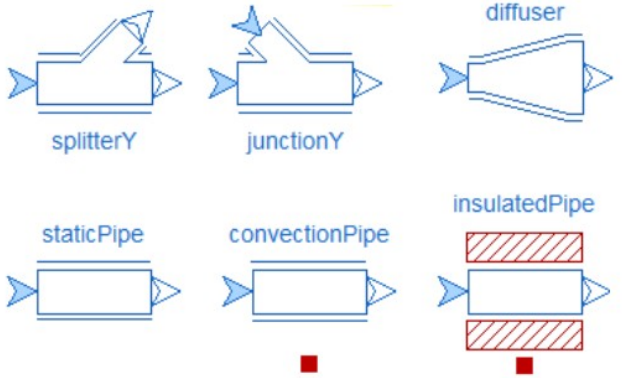
TFS Extension on pipe flow models

- Purpose is to enable complex pipe systems
- Some models have directly been transferred from the Modelica standard library
- Other models have been developed by using loss correlations out of Idel'chick
- The models have been verified and partially validated

Transferred from Modelica.Fluid



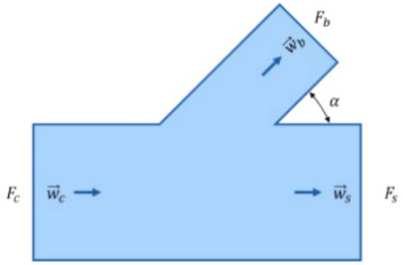
Self developed, based on Idel'chick



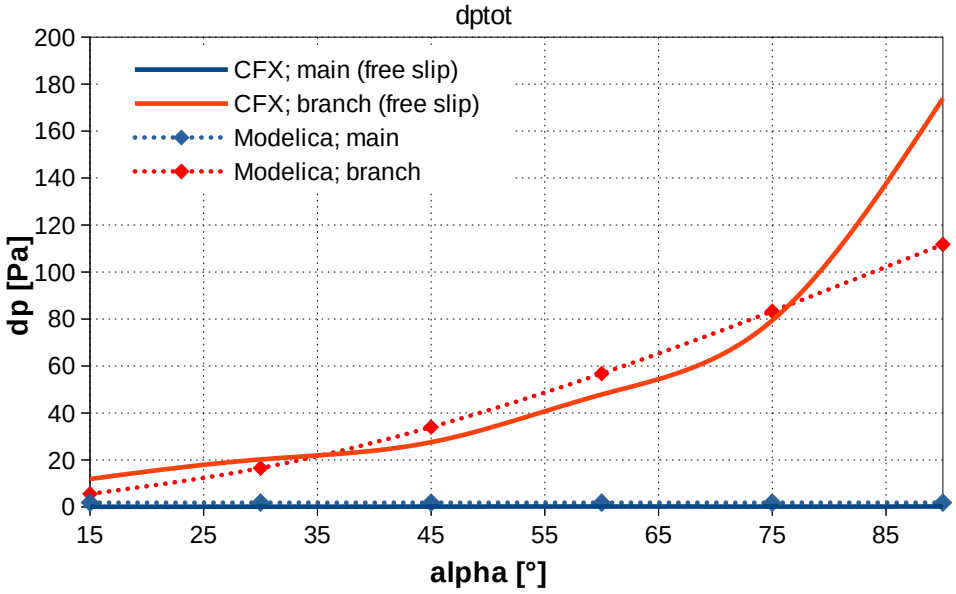
Pipe models

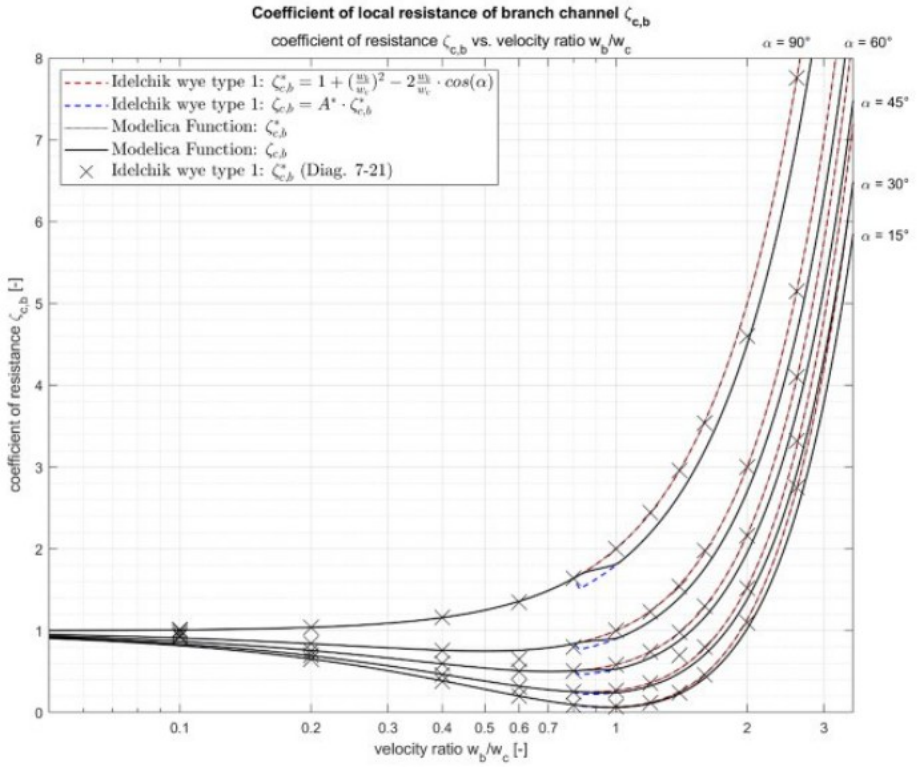
Verification and validation

- Here shown: splitter



Validation against ANSYS CFX



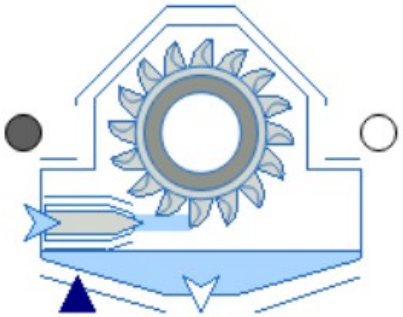


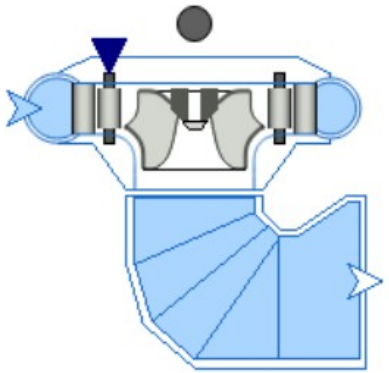
Verification against Idel'chick

Hydro-Turbines

Pelton and Francis

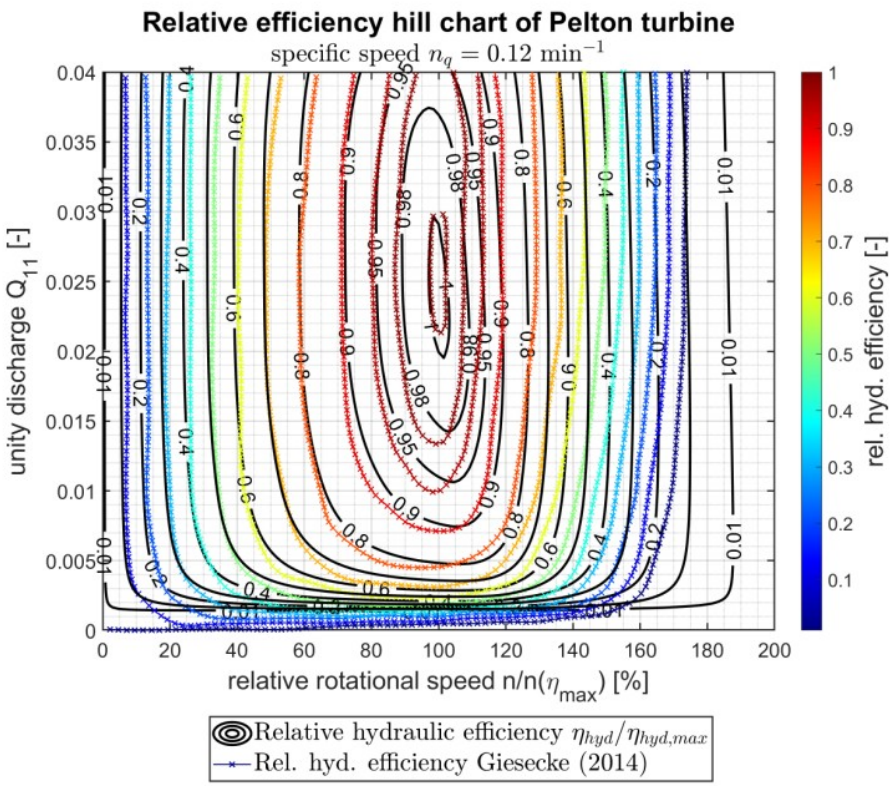
- Hydro Turbines is a rather special subject, nevertheless with respect to energy storage cases and grid stability pretty interesting
- In literature there exists a work on generic 1-D description of hydro turbines
- Motivation of our work was to implement these 1-D descritpion into modelica
- Next step ist to validate the models against real cases in the field
- Further steps may be the development of models for Pump and Kaplan turbines

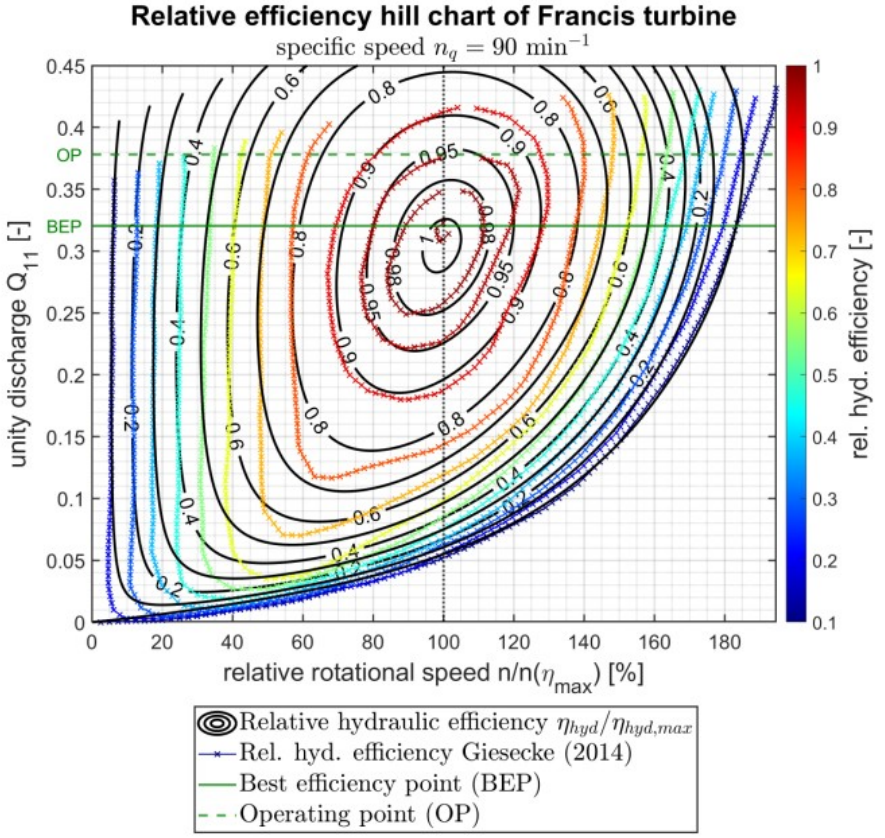




Hydro Turbines

Validation against literature





Conclusion

… and what happens next

- We decided to use TFS because of its robustness and its strength for thermodynamic energy systems
- Our own library extension of TFS was initially developed to support the lectures, but now we think it’s worth to share models with the community
- We started to develop pipe models as we see here the largest most generic benefit
- Hydro-turbines is within our technical field and we intend to cooperate with industry for better validation
- The next intended step is to open an own fork in Github and develop our (TFS-) HTWG Extend, depending on incoming projects
- We are then happy about every user who tests the models and provides feedback for improvement