Federico Giai Pron

District heating system circuit simulator

User guide

Giai Pron, Federico
6-27-2022

Contents

Figures

Symbols

Variables

Symbol	Name	Unit	Unit symbol

Subscripts

Symbol	Name

Superscripts

Symbol	Name

Overview

The following tool allows to simulate arbitrary district heating systems, providing as output the pressure, temperature, mass / heat flow rate at each node of the pipe network, and the system efficiency.

Folders

The folders in which the files composing the tool are located are:

Documentation	, in which the user can find a description of the tool (note: **to be request to the author**)
Solver	, in which the user can find all the scripts / functions composing the tool
Validation	, in which the user can find some of the test cases considered to validate the tool

Input / output file

The tool takes as input one or more input / output excel files (note: all the input / output files must be in the same folder), each containing the following sheets:

- *Commands* , in which the user can find some bottoms to easily clean the input / output file
- *Input* , in which the user shall input the main properties of the pipes network
- *Output* , in which the tool stores the simulation results
- *Residuals* , in which the residuals plots are shown

The main inputs to be provided by the user are:

- The pipe network topology:
  - The coordinates of each node
  - The termination nodes of each element
- The pipes properties:
  - Diameter
  - Thickness
  - Roughness
  - Thermal conductivity
- The boundary conditions:
  - Pressure boundary conditions
  - Node / element source temperature, mass / heat flow rate

The adopted sign conventions are shown in the following picture:

- The element source mass / heat flow rates are positive when the mass / heat flow exits from the first node of the element and enters in the second node of the element
- The node source mass / heat flow rates are positive when the mass / heat flow exits from the node / element

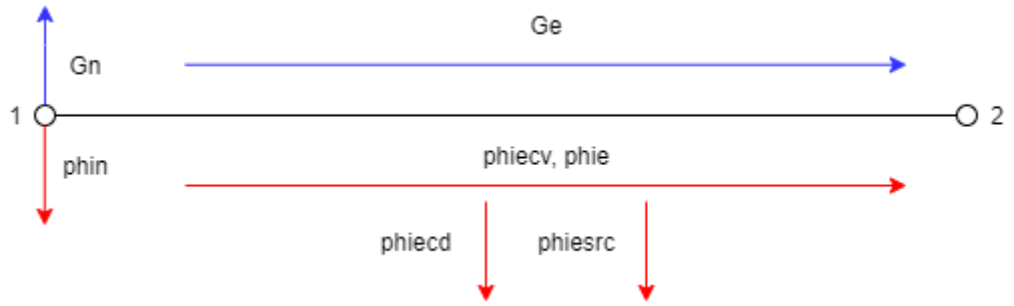

Figure 1 – Sign convention.

Run

To make the tool working it is sufficient to run the *Main.m* file and select the input / output file. A progress bar will be displayed to inform the user about the completion percentage.

Results

The tool returns two outputs:

- The *Output* and *Residuals* sheets of the input / output excel files
- An image, named as the input / output excel files and located in the same folder, in which the main outputs are displayed. An example is shown in the following picture, where $P_{g,f}$, $P_{g,d}$ and $P_{g,u}$ are the net feed power, the net dissipated power, and the net useful power.

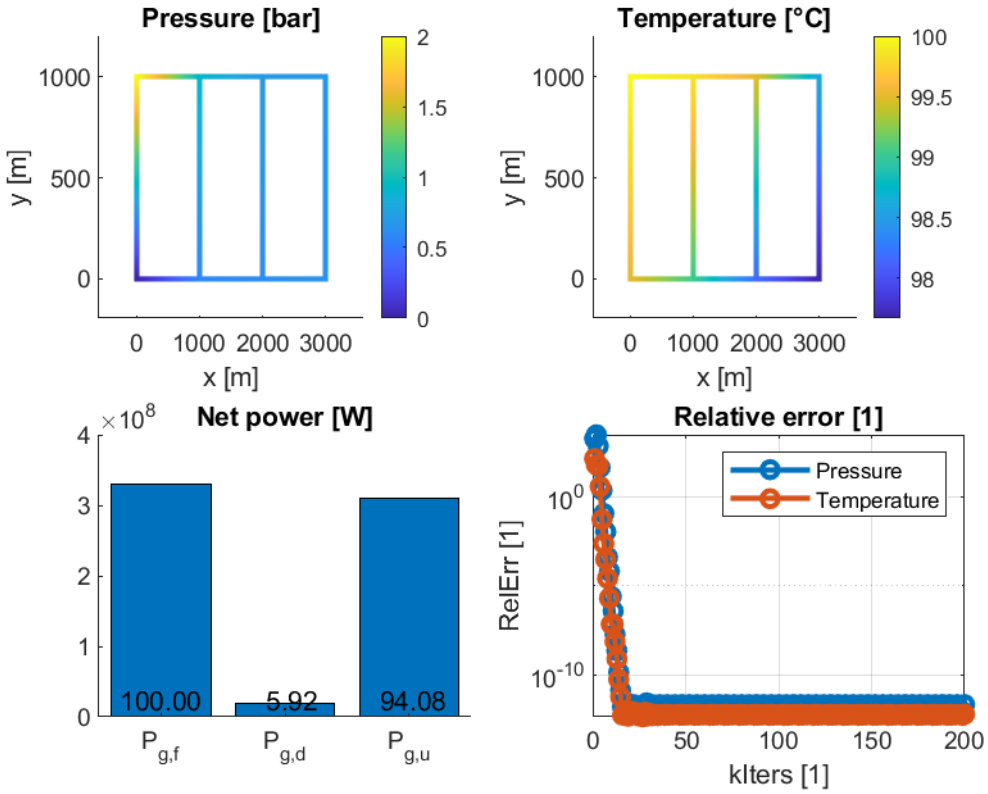

Figure 2 – Example of output image.

Example

- Open the *Main.m* file on MATLAB and click on *Run*
- Select the *TestFile05B_HeatSourceElementPositive.xlsm* file contained in the *Validation* folder. In this example, 4 buildings have been considered.

Figure 3 – Example of network layout..

- Click on *OK*
- Wait until the string *Completed* is shown within the progress bar
- Open one of the input / output excel files contained in the *Validation* folder
- Look at the *Output* or *Residuals* sheet to see the results
- Open one of the *….png* files generated by the tool in the *Validation* folder

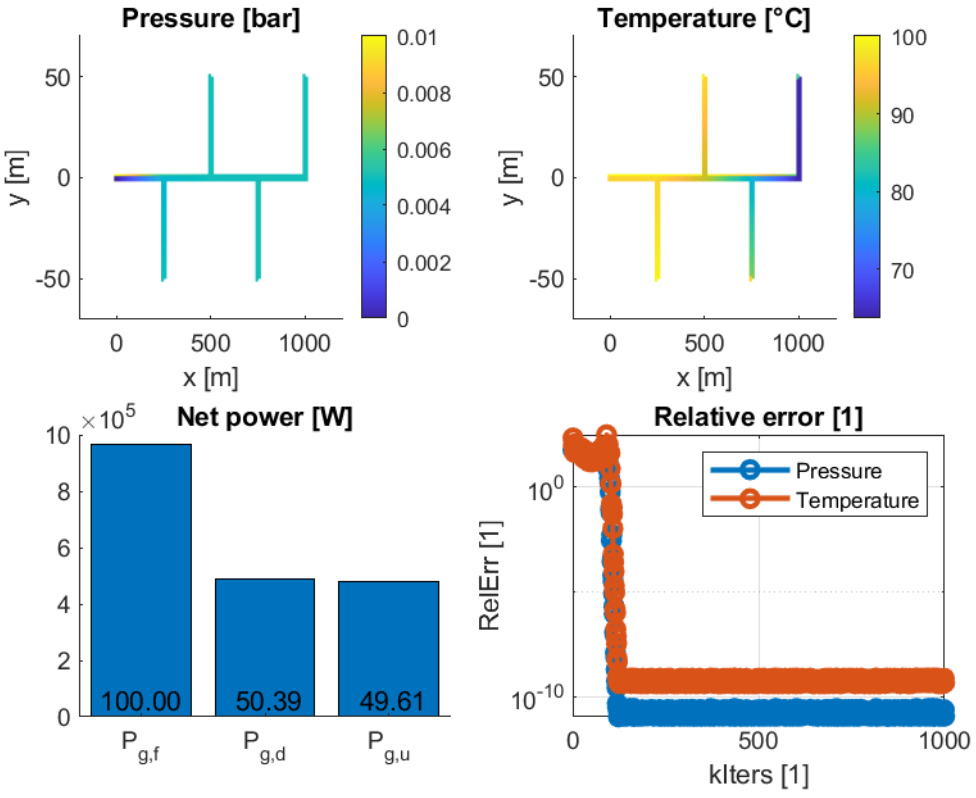

Figure 4 – Example of results picture.

- Try to repeat the same sequence with a new input / output excel file

Contacts

Contact the author (federico.giaipron@gmail.com) for detailed tool description, sources, customizations requests, open access to files.

Note: the same tool could be used, with some adaptations, to simulate any thermal-fluid dynamic system, energy plant system, solar thermal systems, etc.