DIN - DEPARTMENT OF INDUSTRIAL ENGINEERING

PhD Course in Mechanics and Advanced Engineering Sciences (DIMSAI)

PHD STUDENT POSTER - AY *2016/2017* **Curriculum number *3*** **Cycle *XXXII***

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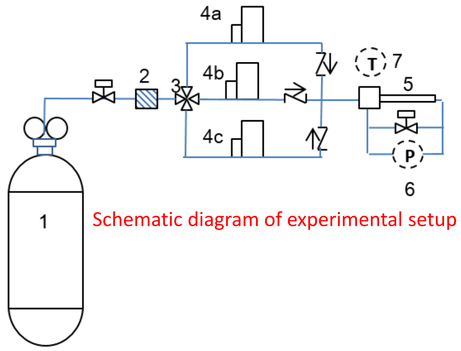
Design of a Micro Heat Exchanger

Experimental Setup



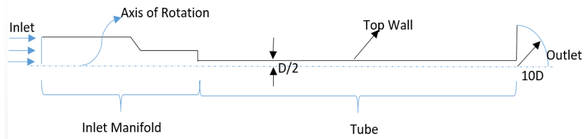
Schematic diagram of experimental setup

Description of components in experimental setup

Label	Description	Label	Description
1	Pressurized nitrogen tank	5	Test section containing - Inlet manifold (HAMLET® LETLOK Reducer) - Mini/micro channel - Outlet manifold
2	7mm particle filter (HAMLET®)	6	Differential pressure transducer (Validyne® DP15)
3	Three way valve	7	K-type thermocouple
4	Flow transducers (Bronkhorst® EL-Flow E7000) - 4A: 0-50 NmL/min - 4B: 0-500 NmL/min - 4C: 0-5000 NmL/min		

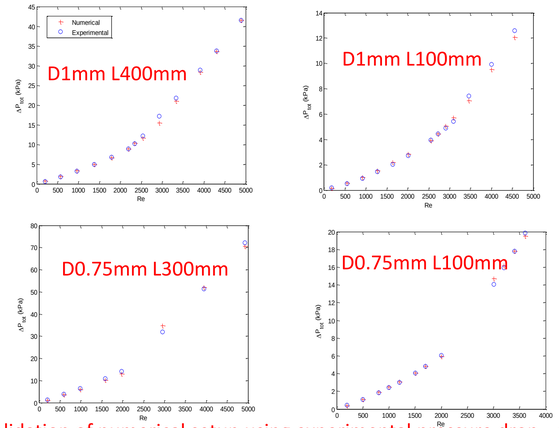
Numerical Setup

Geometry



Boundary	Description
Inlet	- Exp. Mass flow - Turbulence Intensity, $TI = 5\%$ - Length Scale, $LS = 0.038D_h$ - Temperature, $T = 21°C$
Top Wall	- No Slip BC - Adiabatic
Side Walls	- Symmetry/ Periodicity
Outlet	- Pressure opening, $P = 101.9kPa$ - Temperature $T = 21°C$
Dynamic Viscosity of Nitrogen	- 1.77×10^{-5} Pa s

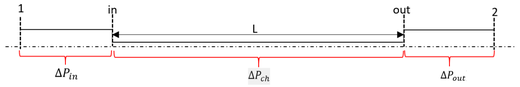
Validation



Validation of numerical setup using experimental pressure drop

Results

Data Reduction



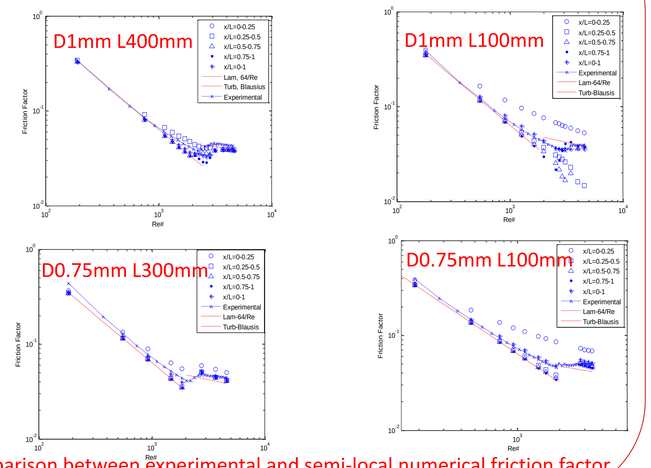
$$\dot{m}_{in} = \left(\frac{\pi\mu}{4}\right) D_h \times Re$$

$$f_D = \left(\frac{D_h}{L}\right)\left[\frac{{P_{in}}^2 - {P_{out}}^2}{RT\left(\dot{m}/_{\Omega}\right)^2} - 2ln\left(\frac{P_{in}}{P_{out}}\right)\right]$$

$$\Delta P_{ch} = \Delta P_{meas} - [\Delta P_{in} + \Delta P_{out}]$$

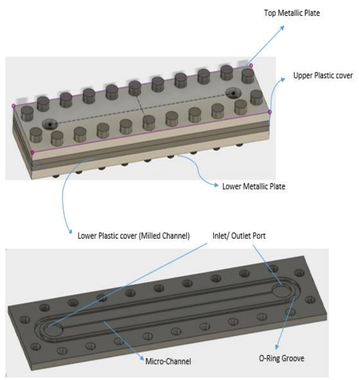
$$\Delta P_{in} = K_{in}\frac{\rho {u_{in}}^2}{2}; \Delta P_{out} = K_{out}\frac{\rho {u_{out}}^2}{2}$$

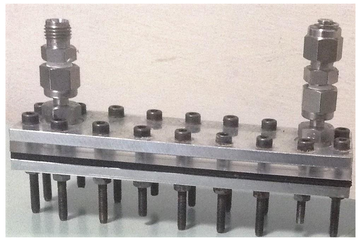
Numerical and Experimental Friction Factor

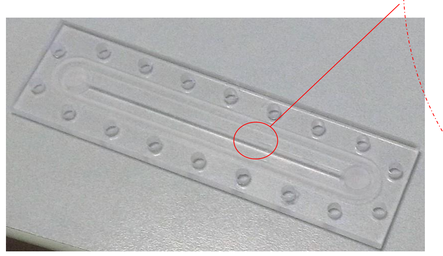


Comparison between experimental and semi-local numerical friction factor

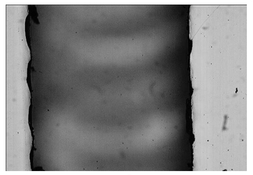
Future Work



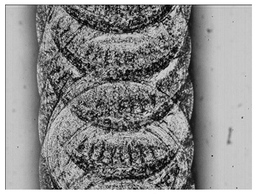




Microscopic View



Top surface



Bottom surface

This publication is part of a project that has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 643095.

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IL PRESENTE MATERIALE È RISERVATO AL PERSONALE DELL'UNIVERSITÀ DI BOLOGNA E NON PUÒ ESSERE UTILIZZATO AI TERMINI DI LEGGE DA ALTRE PERSONE O PER FINI NON ISTITUZIONALI