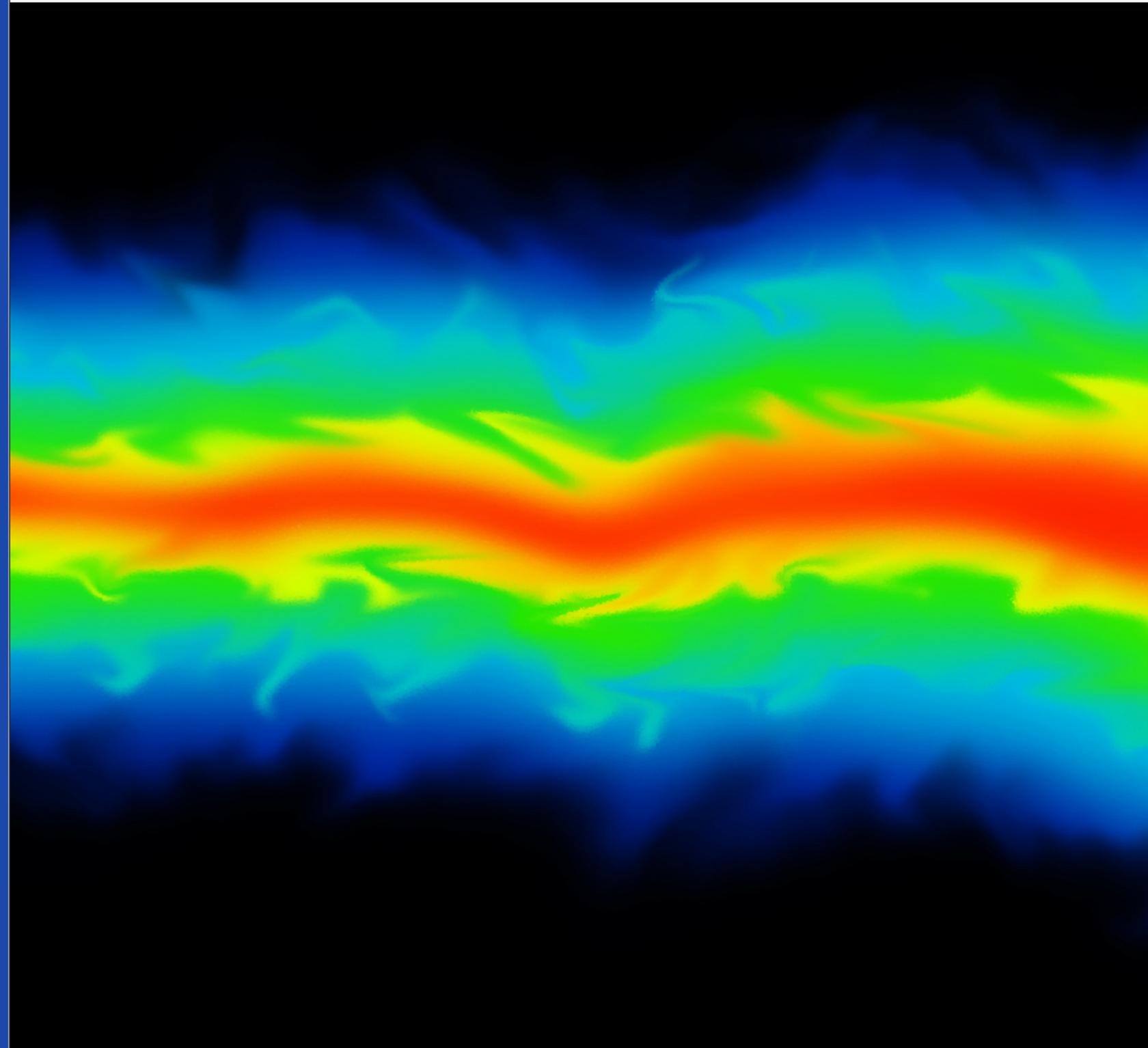
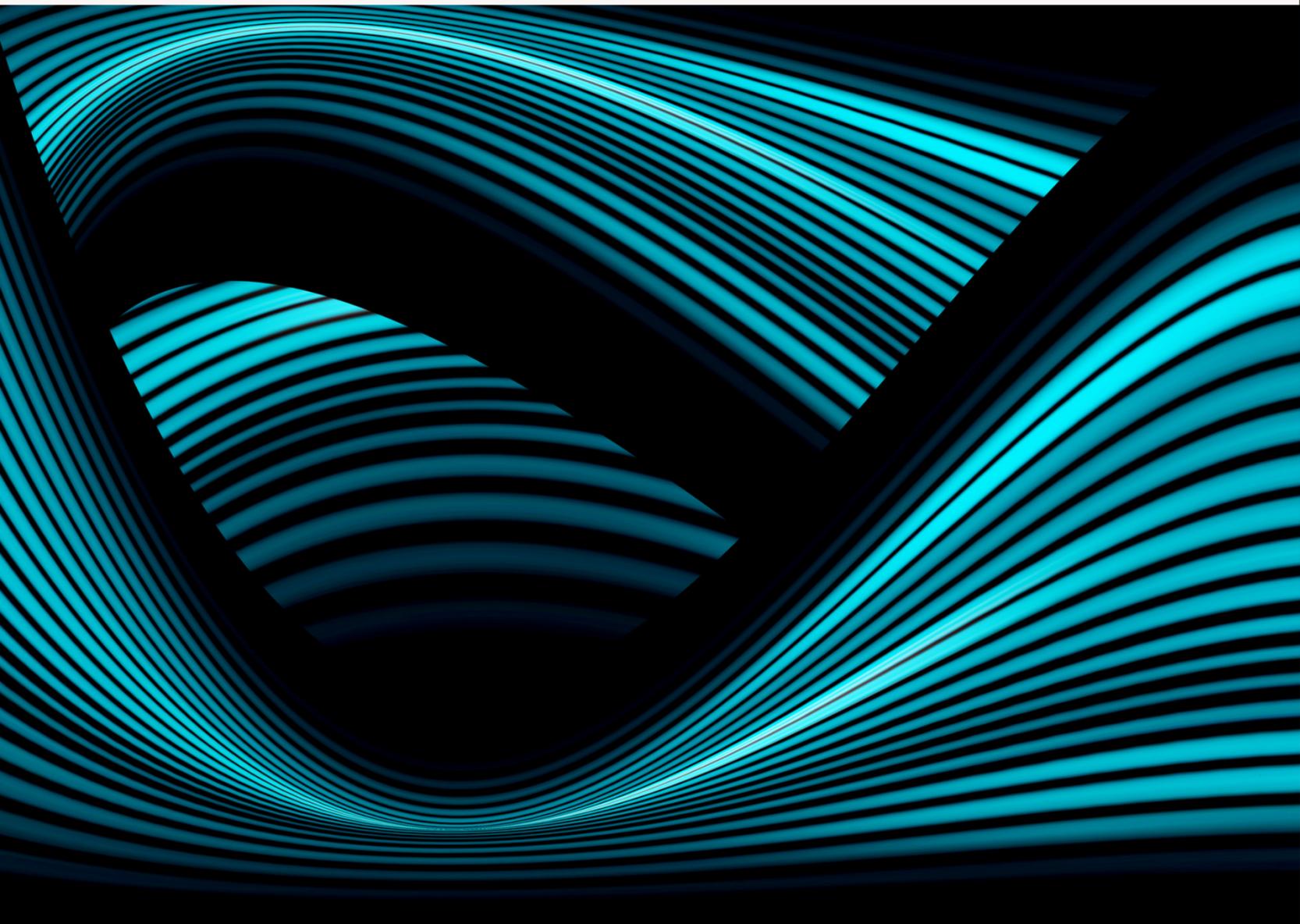


HYDRODYNAMIC SIMULATIONS IN MICROFLUIDICS



Why is hydrodynamic simulation needed in microfluidics?



01

Fast testing of different flow configurations on the microfluidic chip

02

Rapid variation of the chip design

03

Cost saving, as no chips have to be produced





- Applications of hydrodynamic simulation

01

Shear flows

Calculation of shear forces on cells or particles in the flow field

02

Interaction of different fields

The flow interacts with a wide variety of other fields: thermal, electrical, gravitational, magnetic, electro-magnetic.

03

Mixing in the microchannel

Mixing ratios in the microchannel with different liquids and flow dynamics





When is simulation
not right for me?

01

Droplet generation

Moving interfaces are difficult to simulate.
It is possible, but computing-intensive

02

Turbulences

In this case, the simulation has more of a
statistical significance



Simulation methods

OVERVIEW

FDM

Finite Difference
Method

FEM/FVM

Finite Element
Method / Fluid
Volume Method

LBM

Lattice Boltzmann
Method

SPH

Smoothed Particle
Hydrodynamics

Others

Molecular
Dynamics,
Spectral Dynamics
etc.



Analytical testing

01

Goal: verification of the simulation

Mandatory analytical testing

02

Method: approximation

Check with a simplified geometry

Estimation (e.g. estimate rectangular channel by a round channel)

03

Checking the profiles and the grids (meshes)

Does the difference of several grids with different fine meshes converge to 0?





Information needed

Density

Viscosity

Boundary conditions (no slip / free slip)

Pressure or flow rate applied

Possibly further parameters such as thermal boundary conditions etc.





Application example

Same flow rate in different channels
Characterisation of the channel network

Mixing ratio:

8 inlets - 1 outlet

Questions:

What does the velocity field look like?

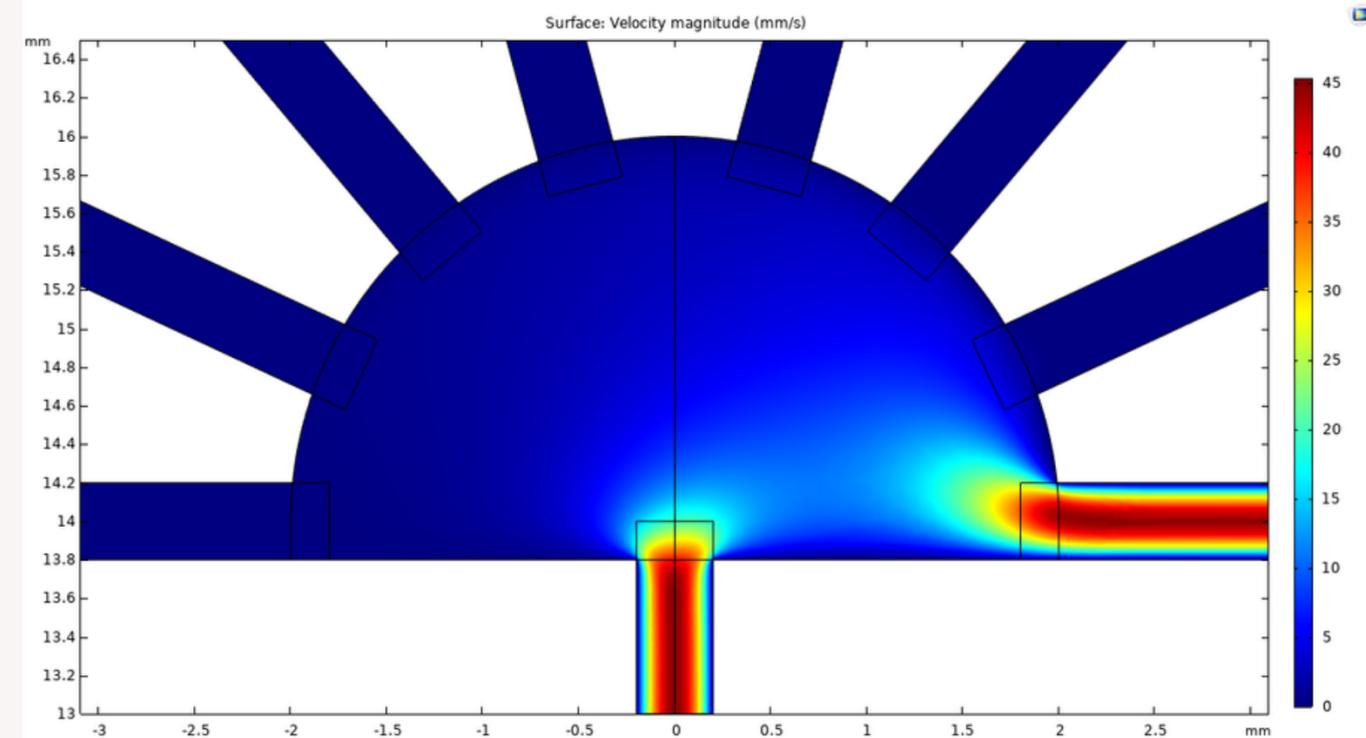
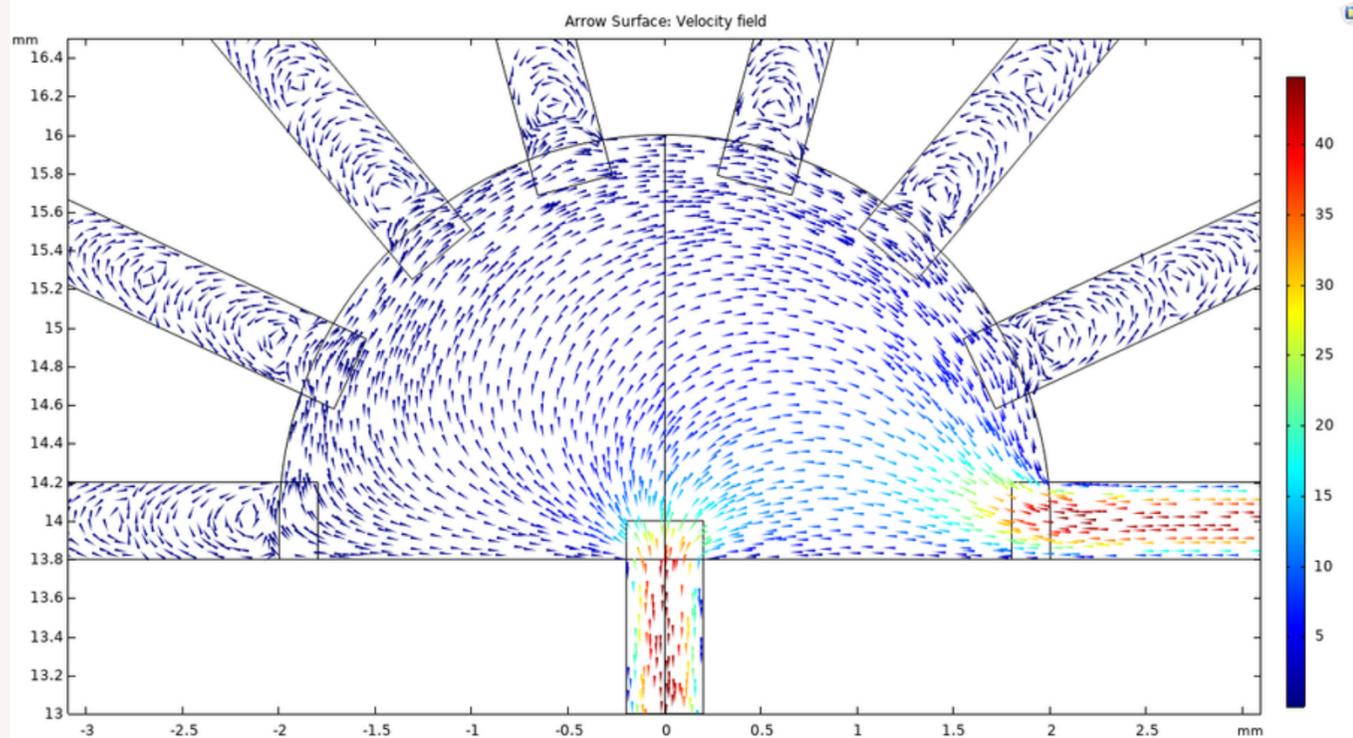
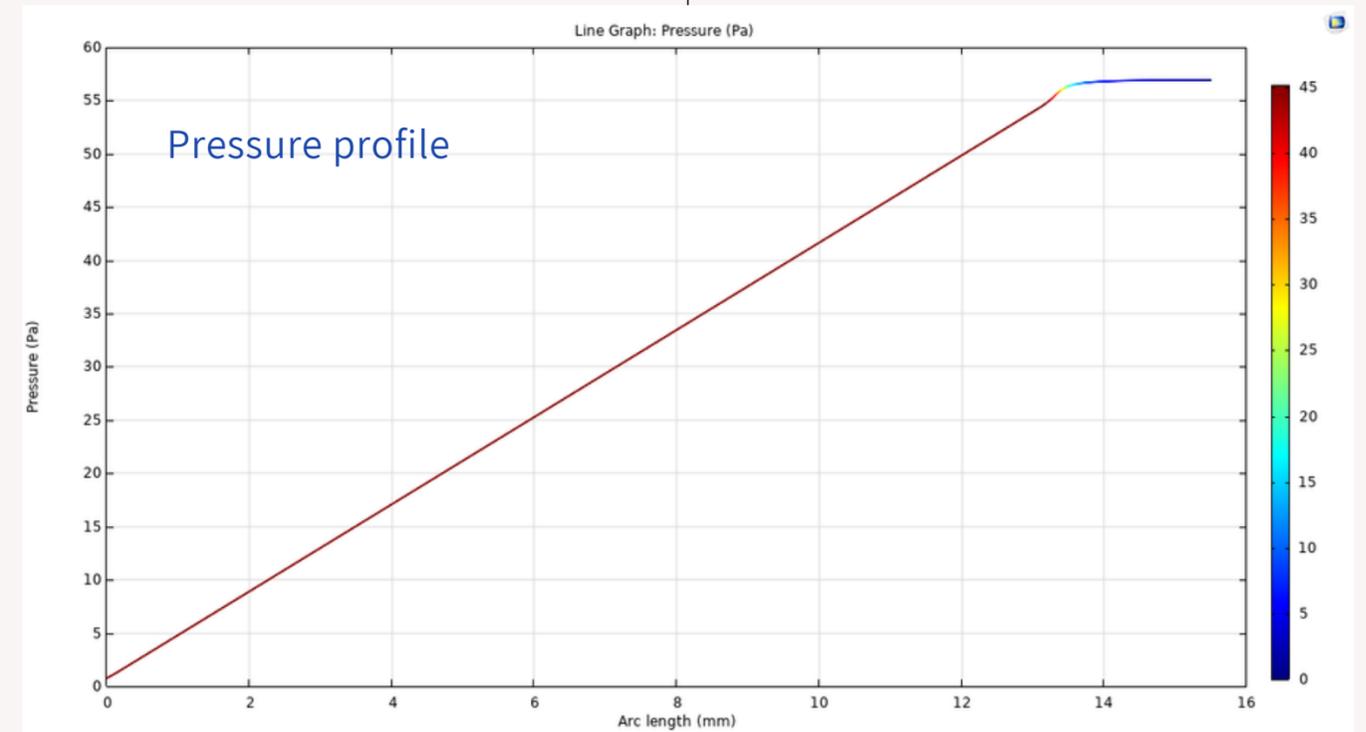
What does diffusion look like (thermal)?

What are the pressures in the system?



RESULT

Solution visualisation and recommendations



Velocity

Magnitude of the velocity field





Talk to us if you are planning a
new microfluidic application:

`contact[at]biophysical-tools.de`

Biophysical Tools GmbH

www.biophysical-tools.de