

Cloud-based multi-physics simulation for designing highly dynamic and highly accurate flow controls for microfluidic applications

Fortissimo Experiment Facts:

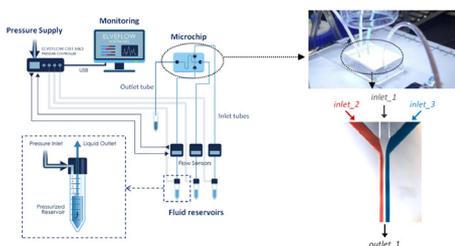
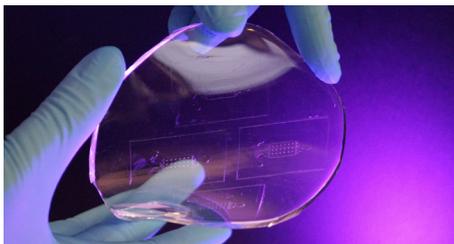
- Industry Sector: **Microfluidics**
- Country: **France**
- Software Used: **OpenFOAM, OpenModelica**

ORGANISATIONS INVOLVED

ELVESYS (End User), from France, is an innovative SME that commercializes the world's widest brand of microfluidic flow control products, enhancing the technological transfer of microfluidic innovations.

GOMPUTE (HPC Centre and Expert), from Sweden, is a leading simulation and HPC solution provider.

ITAINNOVA (ISV and Technology Expert) from Spain, is a public non-profit Technology Centre whose mission is to help achieving a new future through innovation and technological development.



THE CHALLENGE

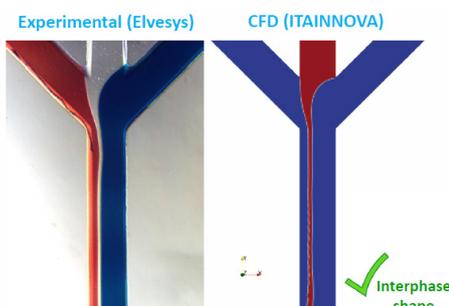
Microfluidics is both the science which studies the behaviour of fluids through micro-channels, typically at sub-millimetre scale, and the technology for manufacturing related components.

The proper control of these systems is complicated as the chips are extremely sensitive to external variations; systems have dead fluid volumes that slow down the reaction time for the controller; and the most convenient sensors are not always available. Thus, the purpose of the experiment is to generate real-time computer simulation of the device that mimics the physical device in order to allow the best dynamic controllability (both in models and real world), namely fast control with high accuracy.

THE SOLUTION

The solution is based on the development of simulation models that can be used both for testing the virtual system and for controlling the real one. These models are used to improve control strategies in two ways: (i) advanced control strategies are allowed because predictions can be used to anticipate the behaviour of the system, which mitigate the effect of sensitivity and dead volumes; (ii) the model can be used as a soft sensor, providing flow characteristics not available by sensing, such as flow depths, interface location or shear stresses.

The development of these models needs HPC. Specifically, Computational Fluid Dynamics (CFD) simulations of the microfluidic chip in service. Batches of CFD simulations need to be run in the cluster in order to build real-time simulation tools based on Reduced Order Models (ROMs).



BUSINESS IMPACT

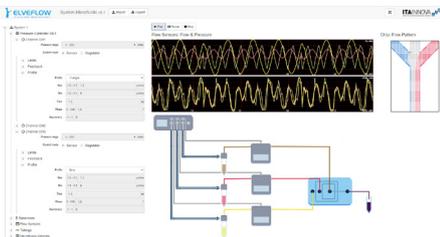
The main business achievement is a methodology to develop accurate model-predictive-control strategies in virtual and real microfluidics systems. A more technically sound and faster offer to clients will be possible by using the novel tool developed, and the information provided by the simulation workflow will allow a continuous improvement of the value chain.

Fortissimo Experiment Partners:

- **Elvesys** (End User)
- **Compute** (HPC Provider & Expert)
- **ITAINNOVA** (ISV & Application Expert)

More Information:

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For Elvesys, this experiment will provide:

- Easy access to microfluidics simulation for their customers by a very attractive cloud-based virtual lab that will facilitate the selection and purchase of microfluidic devices.
- The HPC and cloud simulation/analysis workflow will allow a deep insight into the performance of the products at component and system level.
- New opportunities in the improvement of system controllers.
- An improvement from 5 to 10% of the profit margin per offer.
- Access to a greater share of the Total Addressable Market (TAM), projected to reach \$112 Billion by 2023.

For ITAINNOVA, this experiment will allow:

- Enhance and renew the portfolio of services for its clients.
- Demonstration of the impact of real-time simulation tools on manufacturing sectors beyond this experiment.
- Development of new similar simulation procedures as a consultancy service for SMEs, focused on the use of HPC services for the building and virtual testing of mechatronic setups.

BENEFITS

- Presales argumentation that will increase the lead conversion rate, estimated at a yearly 10% increase in pressure controller sales.
- Reduce the presale cost associated with device lending and demonstration.
- Reduce the discounts given thanks to increased confidence and understanding of the product line.

THE FORTISSIMO PROJECT

Fortissimo is a collaborative project that enables European SMEs to be more competitive globally through the use of simulation services running on a High Performance Computing cloud infrastructure. The project is coordinated by the University of Edinburgh and involves more than 100 partners including Manufacturing Companies, Application Developers, Domain Experts, IT Solution Providers and HPC Cloud Service Providers from 14 countries. These partners are engaged in over 90 experiments (case studies) where business relevant simulations of industrial processes are implemented and evaluated. The project is funded by the European Commission within the 7th Framework Programme and Horizon 2020 and is part of the I4MS Initiative.

I4MS Fortissimo is part of I4MS ICT Innovation for Manufacturing SMEs: www.i4ms.eu



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