Newcastle University | process intensification group | School of Chemical Engineering & Advanced Materials

Impromptu:

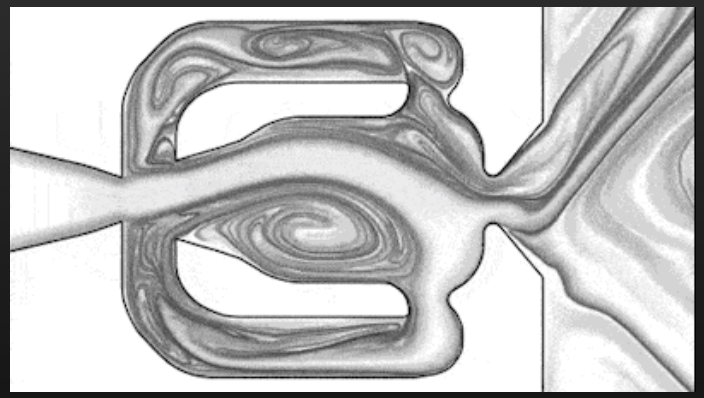
Applications of 3D printed fluidic oscillators for process intensification

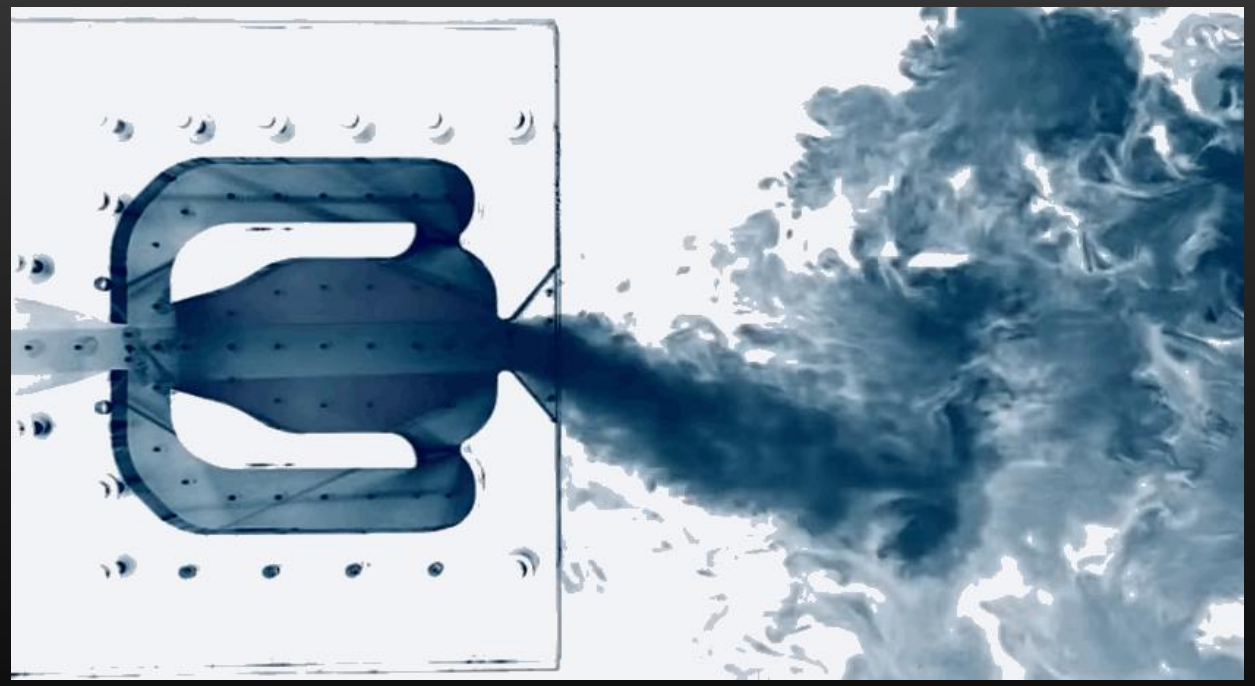
Jonathan McDonough, Dr Richard Law, Prof Adam Harvey

25th Process Intensification Network (PIN) Meeting

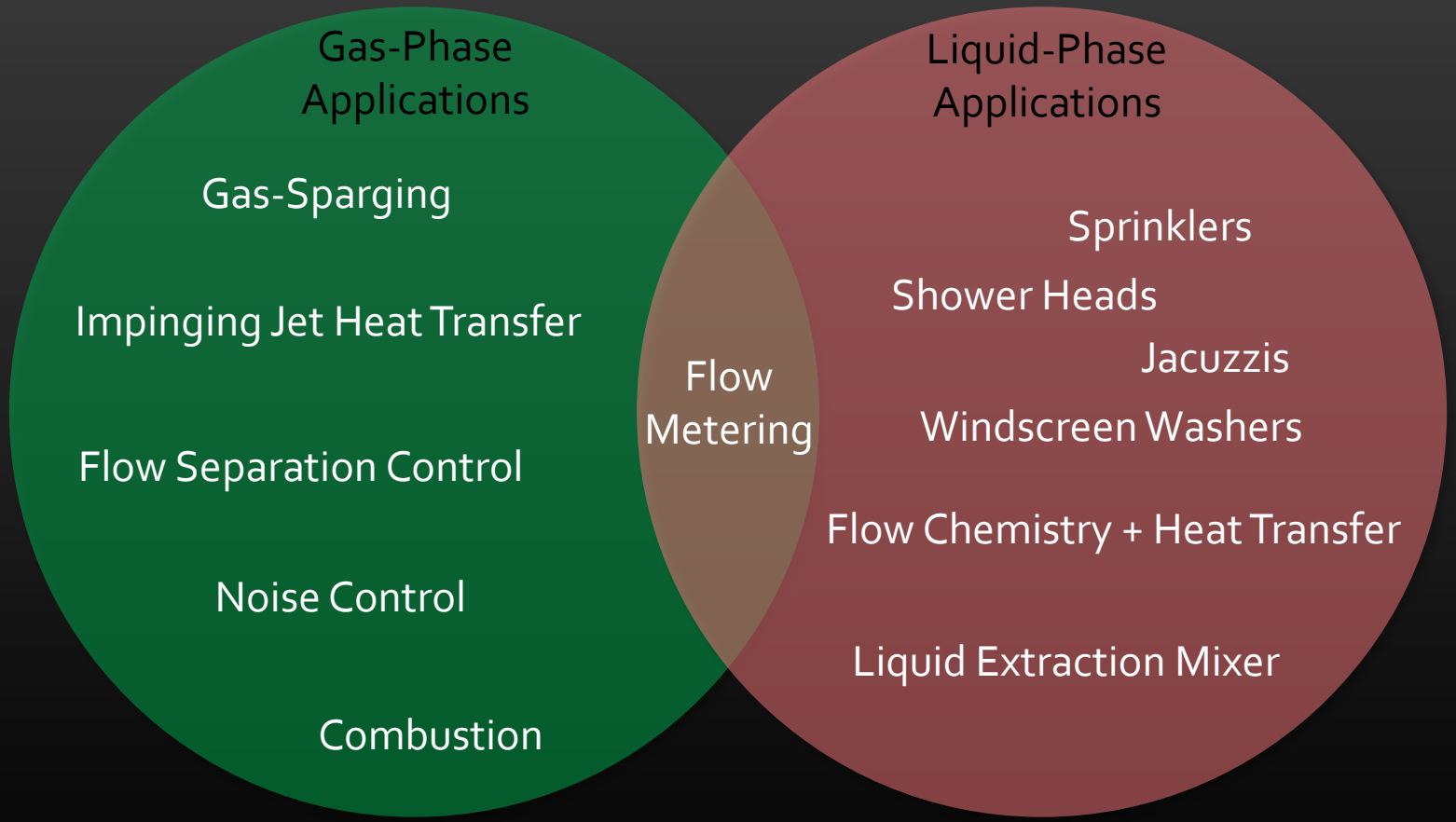
Wednesday 21st June 2017, Merz Court, Newcastle University

Fluidic oscillators produce autonomous oscillations that could be exploitable for process intensification

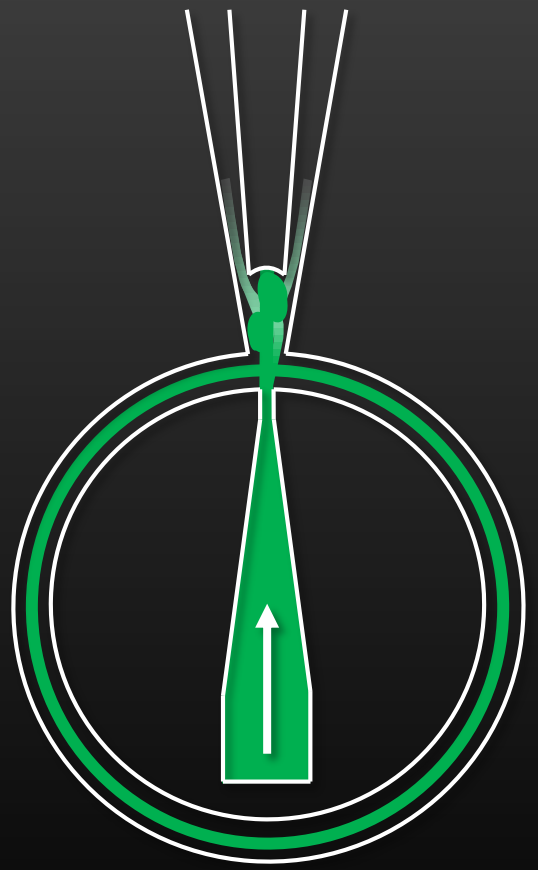




There are numerous distinct gas-phase applications. Liquid applications are less established.

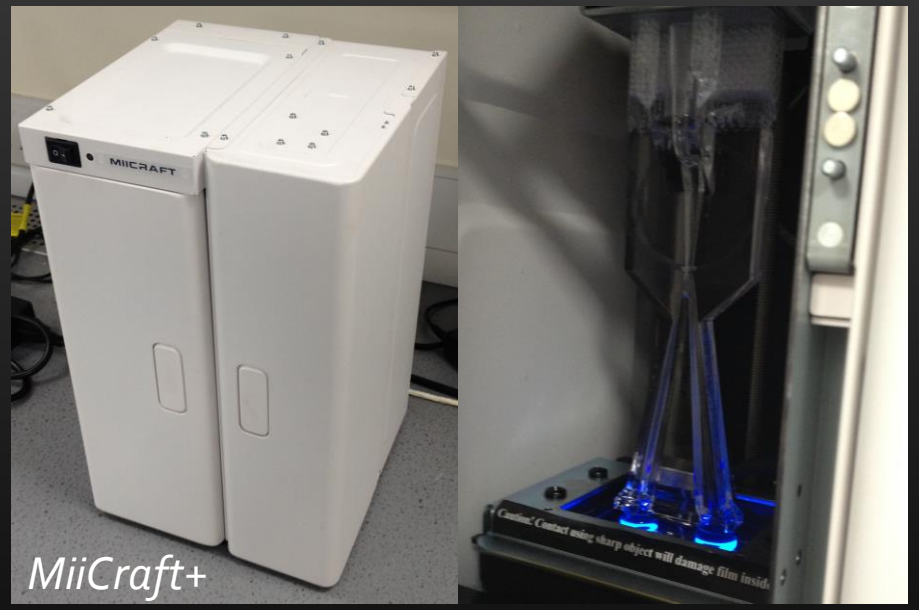


Bi-stable single feedback loop oscillators

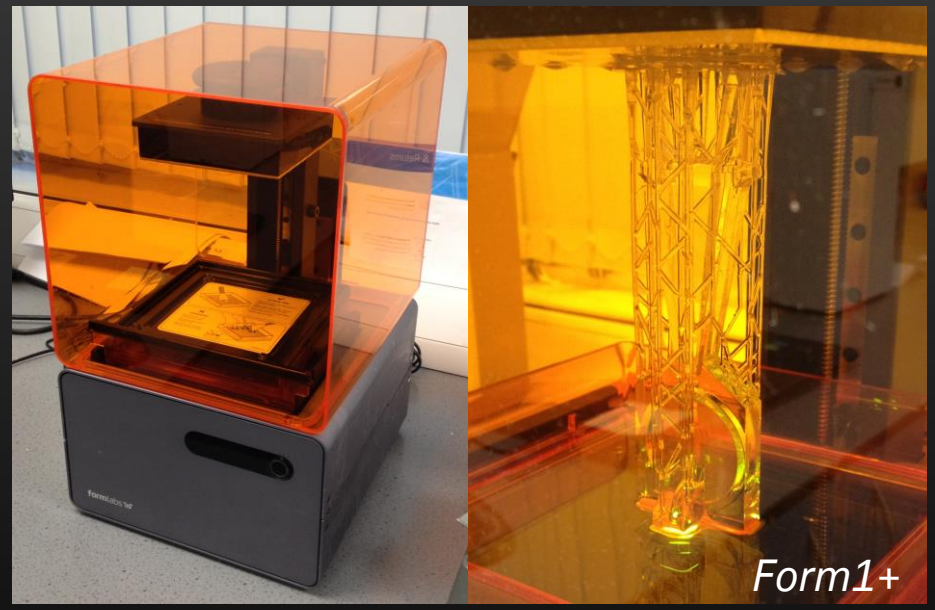


- Jet formation through nozzle
- Wall attachment (Coandă effect)
- Separation vortex
- Second stabilisation vortex
- Feedback flow (pressure gradient)
- Vortex growth
- Critical point
- Jet switches to other outlet

Fluidic oscillators can be rapidly prototyped via 3D printing (SLA method)

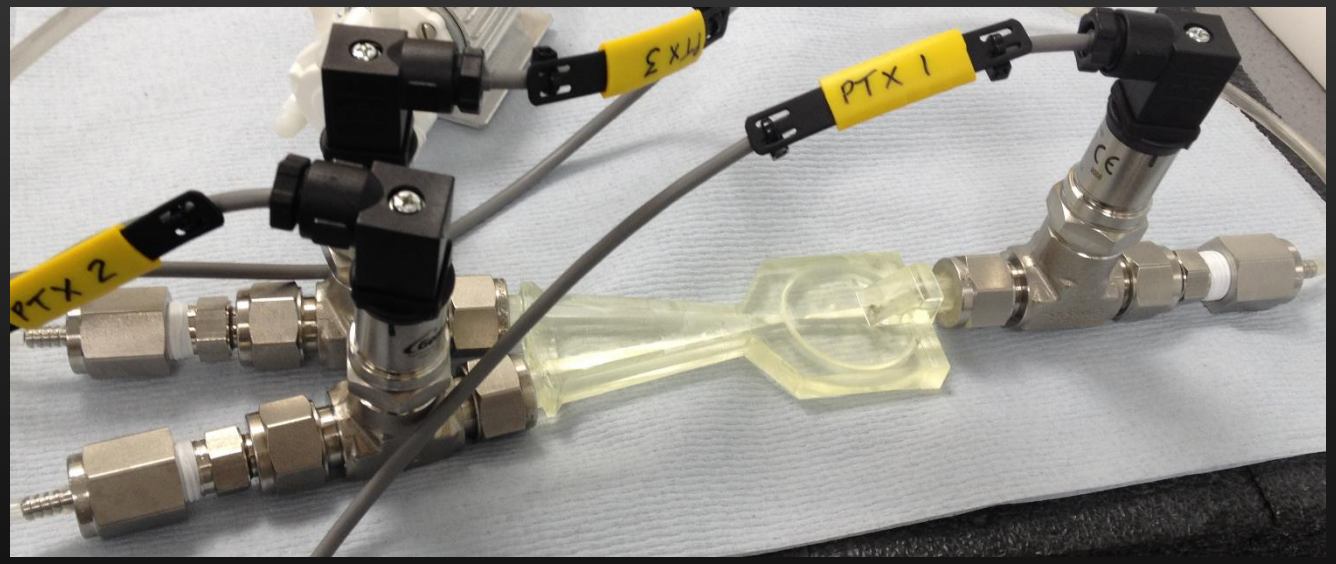


MiiCraft+

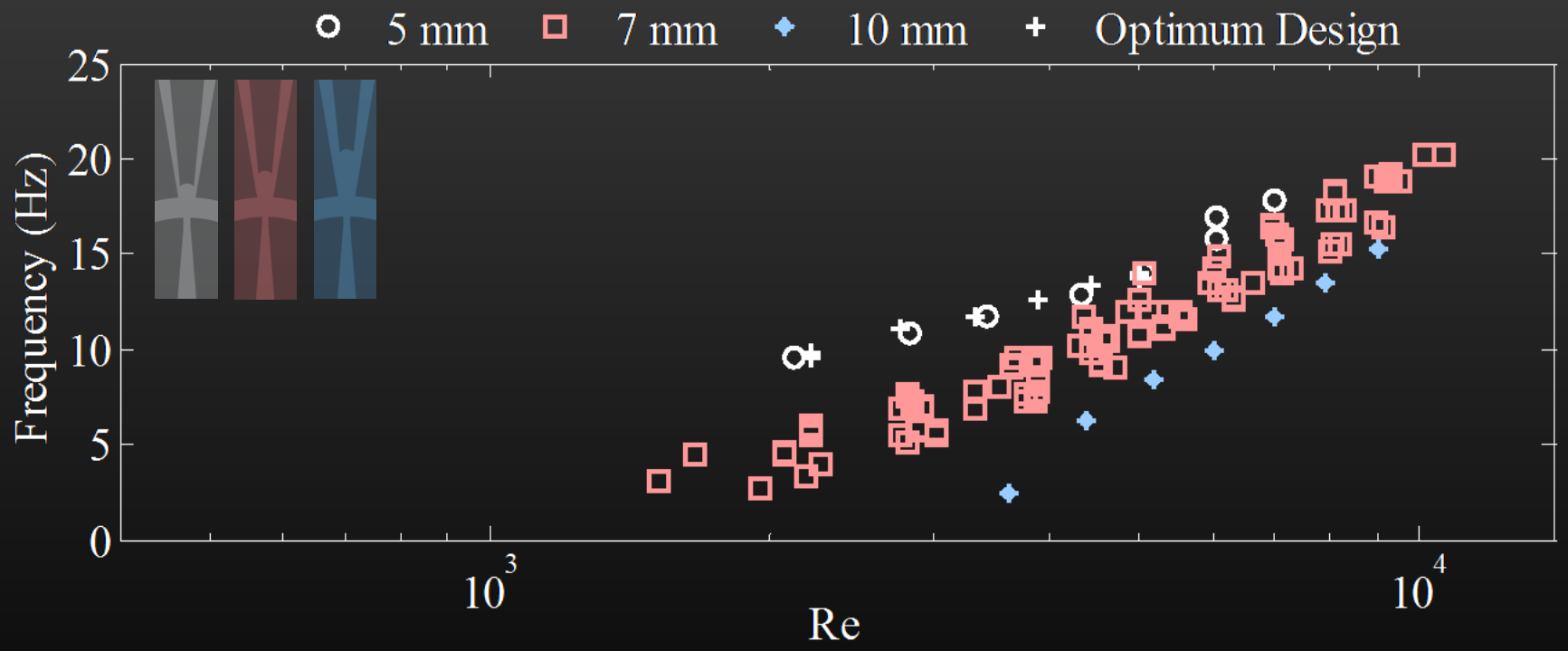


Form1+

An example 3D printed oscillator

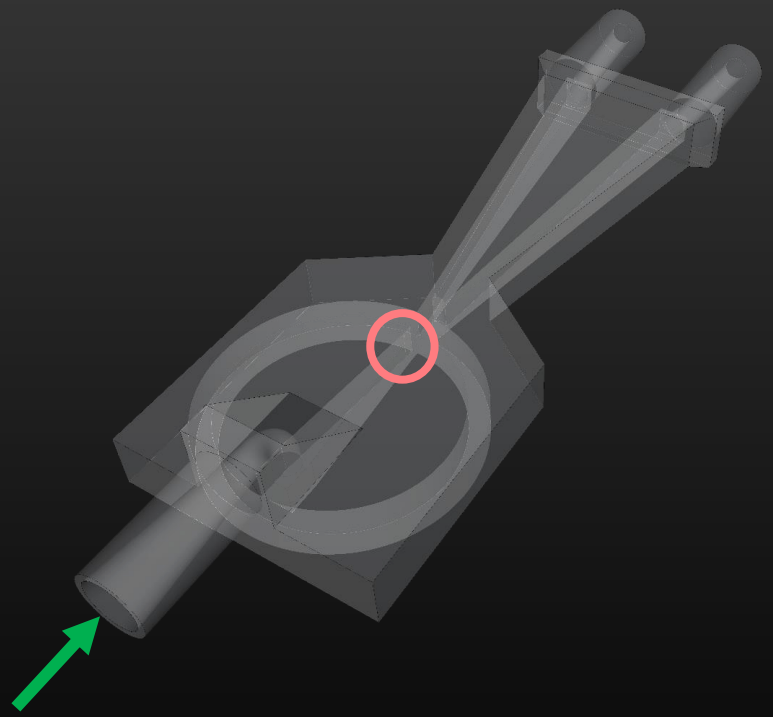


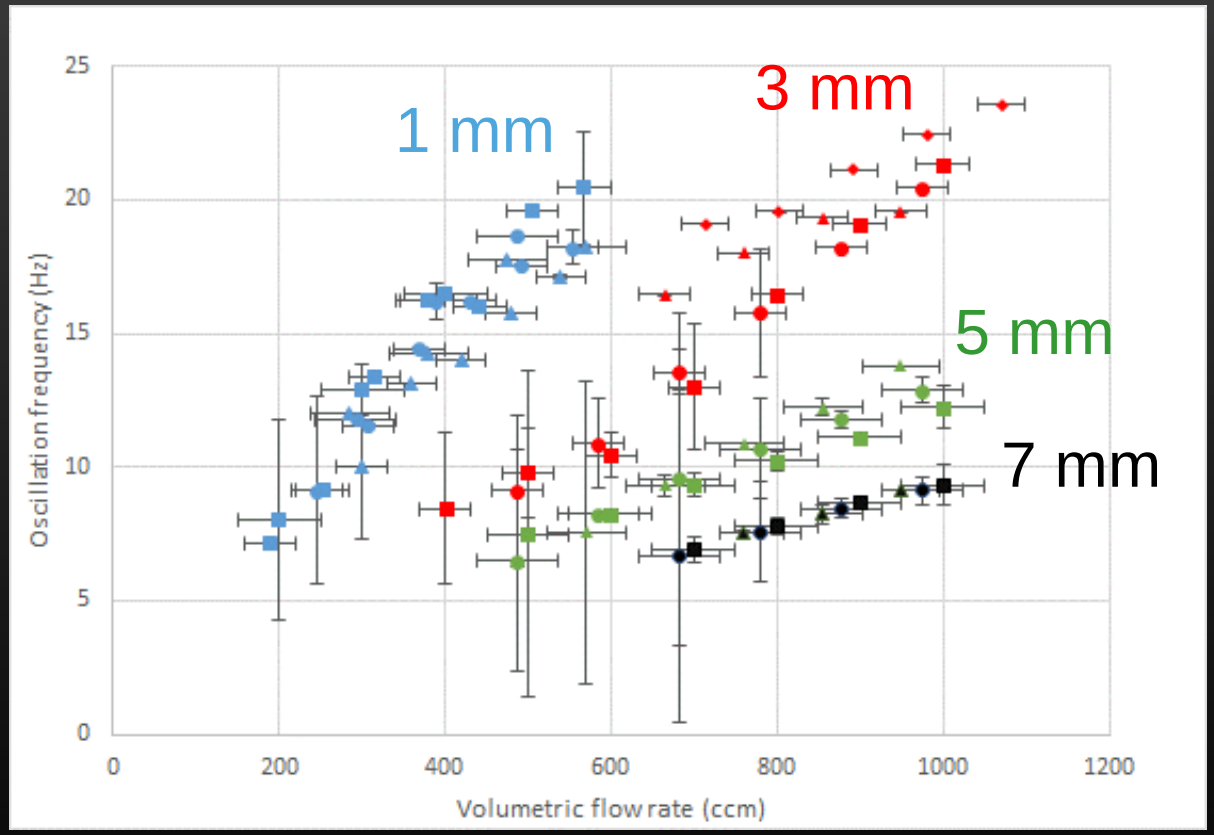
The selection of splitter distance dominates the flow-switching response



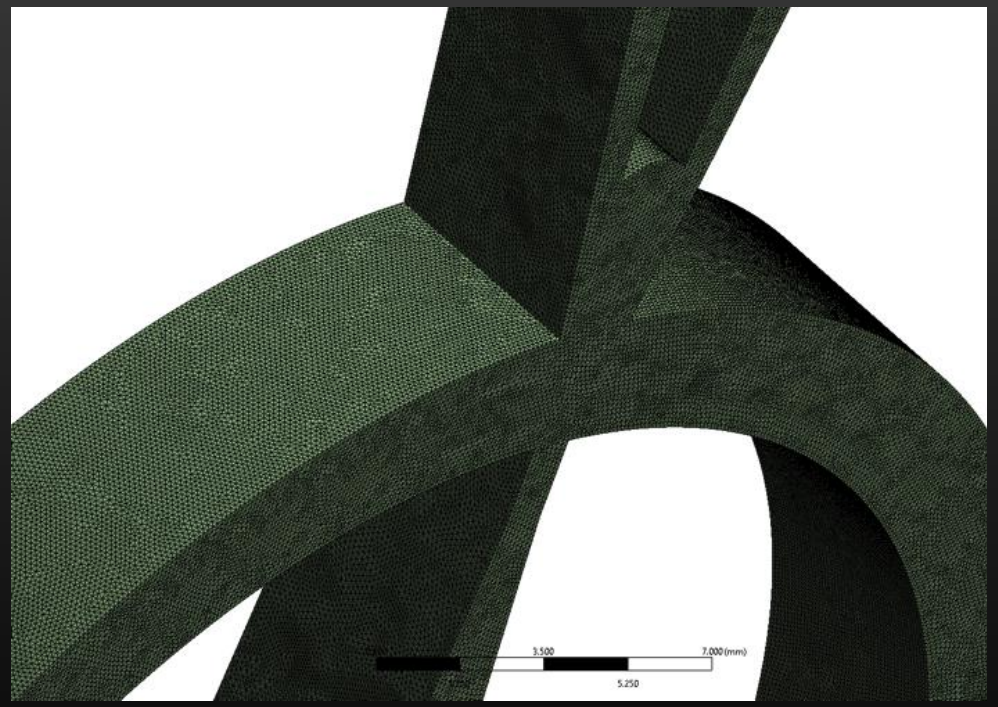
McDonough JR, Law R, Kraemer J, Harvey A. Effect of geometrical parameters on flow-switching frequencies in 3D printed fluidic oscillators containing different liquids. Chemical Engineering Research and Design 117 (2017) 228-239

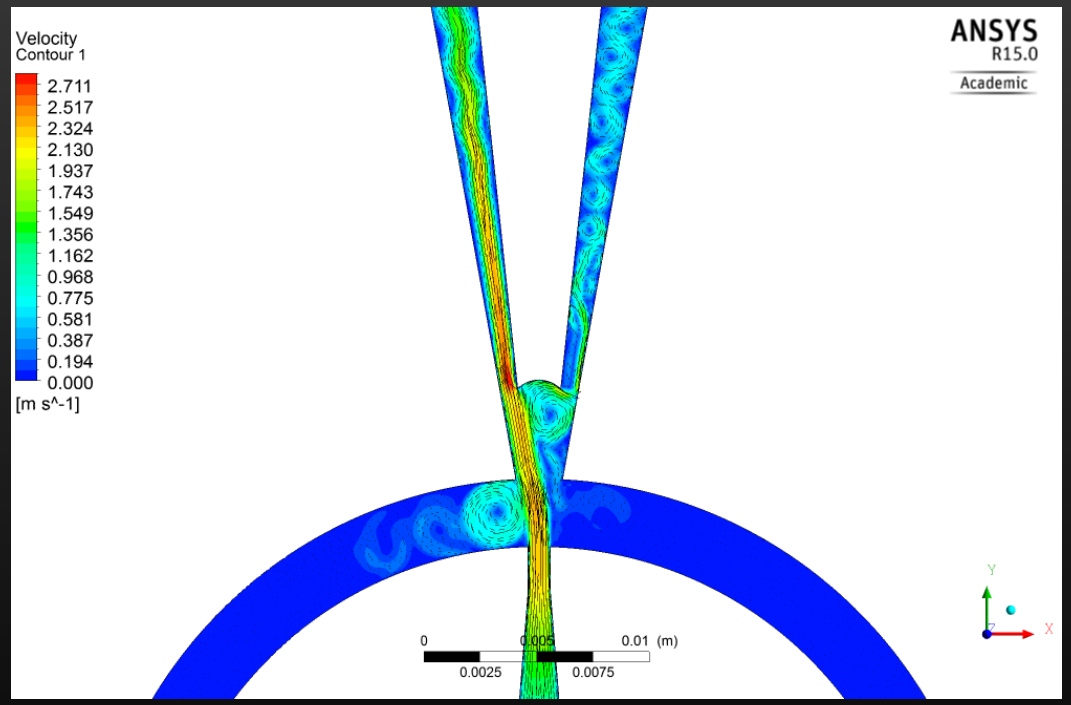
The volumetric flow rate can be decoupled from the jet velocity by changing the channel height



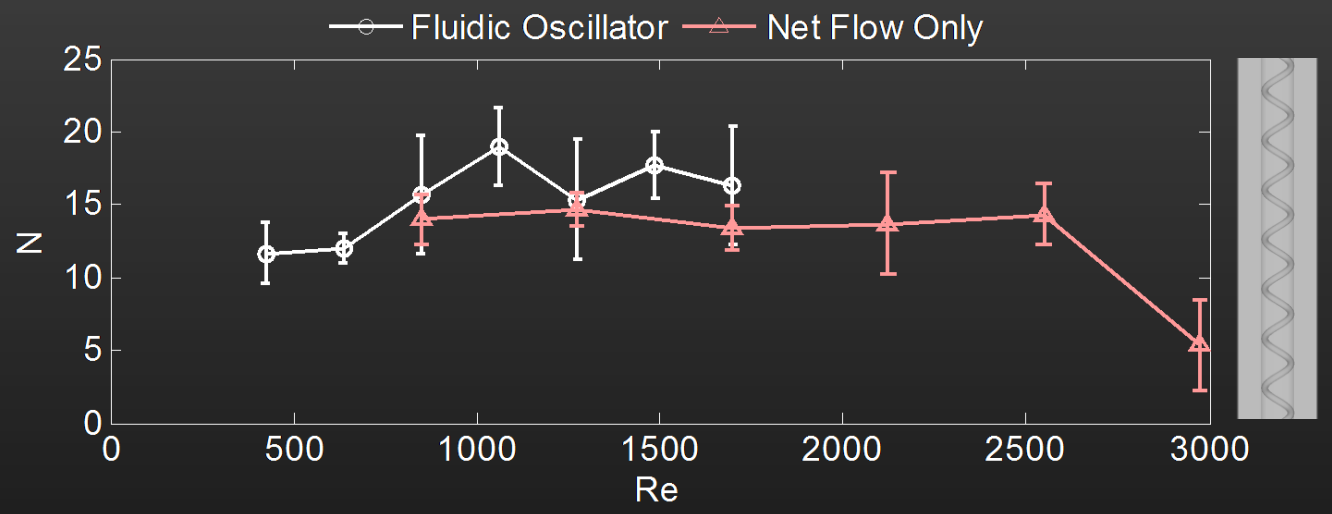


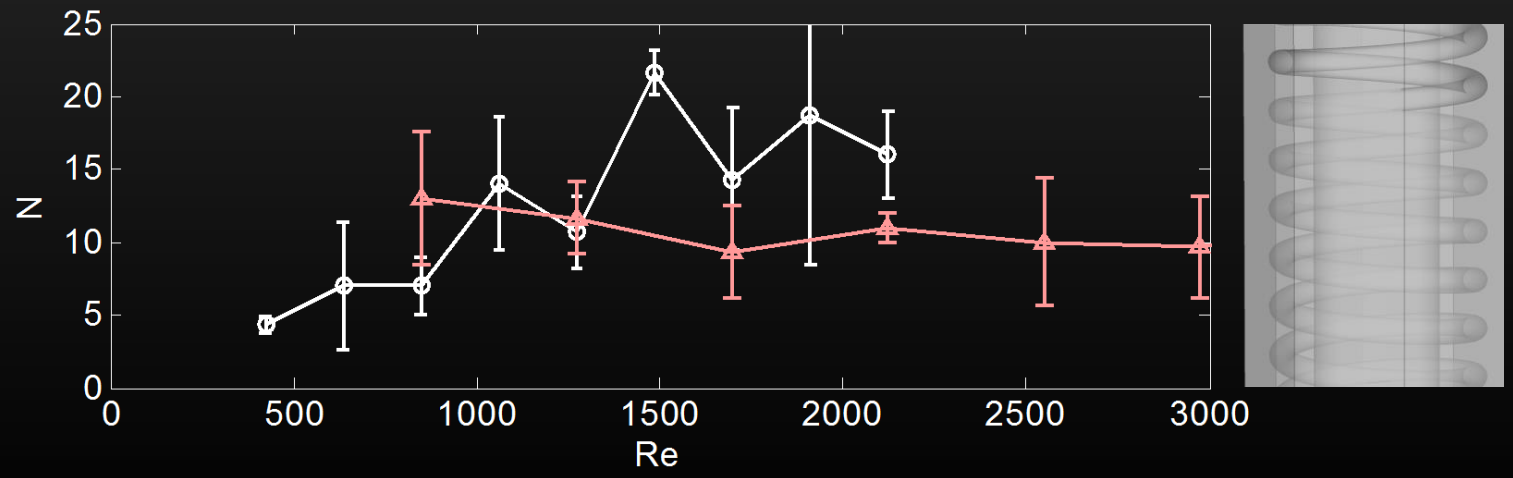
CFD modelling is also being employed to study the onset instability that leads to flow switching



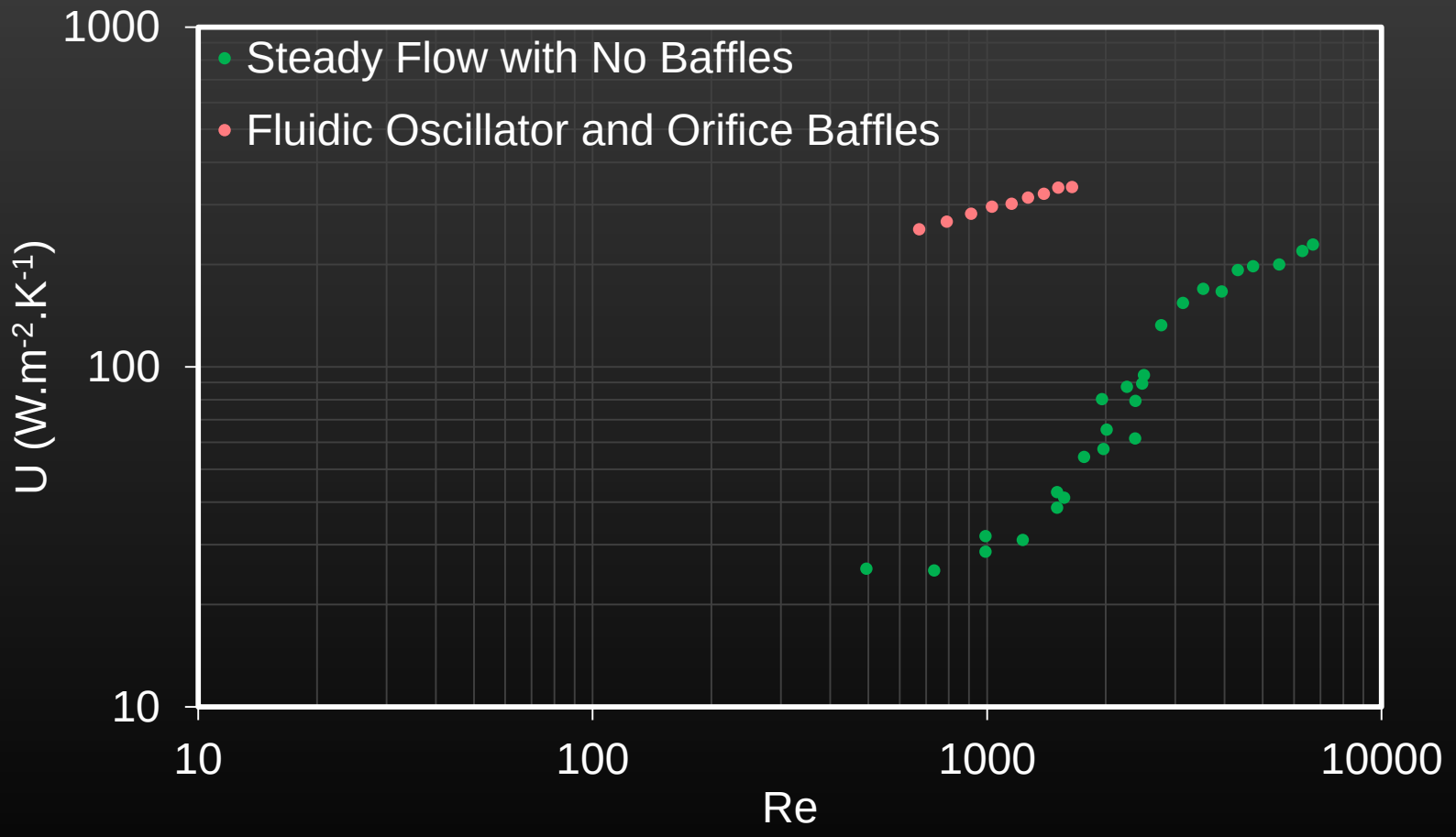


Preliminary results suggest that improvements in plug flow quality are attainable.





The combination of pulsatile flow and orifice baffles produces an order of magnitude increase of U



Questions?