Hi Reddit, I am Aaron Wheeler of the University of Toronto. Ask me anything about the study and application of fluid flow on devices with features in the micrometer length range!

What is different about the way a fluid behaves on a large scale (say, a swift-flowing river) and the micrometer scale? What causes these scale differences? And are these differences "universal," or do they vary by the type of fluid (water vs. liquid methane, for example)?

kiri-kin-tha

Good question. There are many differences. An obvious one -- inertia is important in macro-scale fluidics, but it is much less important in micro-scale fluidics (where viscous forces typically dominate). The end result: flow in microfluidics is laminar, meaning that analyte transport is dominated by diffusion. A famous/beautiful picture of laminar flow can be found on the cover of Science nearly two decades ago.[1]

This technology seems to be at broad intersection of a handful of different sciences. How closely do you work with chemists, biochemists, nanotechnology and biotechnology? Would you say one of them is more influential than the other and if someone is looking to get into the microfluidics field, what might their educational path look like?

brokenzion410

Absolutely -- there are myriad paths to get to this space. My background is chemistry (which colors my view of the technology). But physicists, engineers, and applications-specialists have made important contributions.

If interested in this technology, the 'discipline' you study is not so important. Find researchers doing interesting projects, and volunteer to help. We certainly need it!

The microfluidics-based hand-held analysis system sounds very promising. Healthcare is an obvious, important application (particularly in remote areas), but what other uses do you hope to see with devices like these?

Lewsk55

Good point - healthcare is just scratching the surface. See this paper[1] describing a distributed microfluidic system (or something similar) used to report the environmental conditions that plants are experiencing. Or this paper[2] describing a hand-held system that teaches students about the behavior of model organisms.

Bottom-line: the application-space for this technology is incredibly diverse -- if you are interested in it, someone is doing it. (Or if not, you should!)


What's the coolest application of microfluidics you've seen in the last year?

Paleymir

Hard to pick the 'coolest', but I referenced this one in another comment:
http://pubs.rsc.org/en/content/articlelanding/2017/lc/c7lc00930e#!divAbstract

It's a system that measures 'stomatal aperture' in plants (i.e., the state of the valve that regulates water vapor/etc. exchange in plant-leaves). Imagine a network of these on a field of crops (or on trees in remote forests) reporting the environmental conditions to the farmer/scientist back home!

What are some of the biggest (microfluidic) challenges in creating field devices for medical applications? Thanks for your time!

kiri-kin-tha

What are some of the biggest (microfluidic) challenges in creating field devices for medical applications? Thanks for your time!

Wow, where to begin. Some (not all) challenges include: - Making devices work in the field is far more
challenging than making them work in lab (where you have a large suite of tools available to trouble-shoot and fix, etc.) - Making 'medical' measurements is important -- you can't afford to get it wrong! So optimizing the devices/methods for absolute best performance is critical. - My team is good at making systems that work for us (nerds who devote our lives to this). But how do we make these systems work well for non-experts? This is a big challenge. - How do we find the people and cases that could most use the new technologies? My team (alone) has no clue -- we rely on our wonderful collaborators to focus our efforts.

Okay, last question from me. I know I'm abusing the privilege! How did you become interested in microfluidics?

kiri-kin-tha

Good question. As an undergraduate, I enjoyed chemistry research -- particular the parts in which I had a chance to develop new instruments/methods for quantitation -- this led me to analytical chemistry. In graduate school, I was introduced to microfluidics by a postdoctoral fellow in my research group. I fell in love with the idea of harnessing micro fabrication techniques to build systems capable of making measurements in complicated systems, and I haven't looked back!

Can you share any cases of DropBot or PotentioStat being used in the developing world or non academic environments since you released the instrument designs as Open Source?

Paleymir

We have received reports from several people/groups outside of academia who are building and using DropBots and DStats (our two open-source platforms), ranging from hobbyists to small companies. It is fun to think about the systems being used (and hopefully improved) for applications that we have never thought of!

The only example of DropBot and DStat being used in the developing world (that I am aware of) is our field-work in Kenya (both systems were used there). I would love to see others!