

# Careers

## Under sea, over land

Acoustic scientist **Daniel Finfer** describes life at Silixa, a start-up firm that provides fibre-optic sensing technologies to the oil and gas industry

In the summer of 2009, I was in the middle of a postdoc on biomedical ultrasonics at Imperial College London, and my mind had started to wander. I found my work technically challenging, and I enjoyed the interactions with my colleagues, but I was ready for something different and I longed to work in a faster-paced environment. So I started to hunt around, and after a long job search, I came across a new company called Silixa.

Upon investigating Silixa's website, I learned that they had created a technology called distributed acoustic sensing (DAS) that lets you listen to the sound at every point along a fibre-optic cable, with a spatial resolution of one metre. This technology has applications throughout the oil and gas industry, such as acoustic imaging of hydrocarbon reservoirs (known as seismic acquisition), pipeline monitoring, in-well fluid surveillance and flow measurement. It seemed like DAS technology could lead to an engaging and challenging career, so I applied to Silixa and was hired as an acoustic scientist.

### Listening under the sea

Soon after I joined, I got involved in project-managing a collaboration between Silixa, the UK Technology Strategy Board (TSB, now known as Innovate UK) and Statoil, the Norwegian state oil company. To understand why Statoil was interested in a technology that gives operators sound-based data from fibre-optic cables, it helps to know how conventional seismic acquisition operations work. Usually, to take seismic measurements from within oil wells, operators have to shut the well in and slowly lower invasive hardware into it while carrying out an acoustic survey. This approach takes a long time and can get very expensive, very fast: companies can lose the equivalent of more than \$1m a



**Sensing a start** A rare sunny day at the Silixa large-scale flow measurement facility in Hertfordshire, UK.

day in lost production while they carry out such surveys.

Fortunately, many of Statoil's wells in the North Sea already had fibre-optic cable – they had installed it when the production piping was completed, to provide communication from the surface to individual measurement gauges further down the well. So, once DAS was installed at the surface, these same “communication lines” could be used as massive acoustic sensing arrays, making it possible to obtain acoustic data within the well at thousands of depths simultaneously, without requiring any additional “downhole” hardware.

Although making sure that all of the equipment and people were in the right place at the right time for the project was occasionally stressful, it was very satisfying when we executed our first multi-well trial in the North Sea. This survey involved four synchronized DAS units that captured seismic data records from multiple wells several times per minute – a feat complicated further by the requirement that each seismic record be triggered by a radio signal sent from a moving, noise-generating boat located several miles from the platform.

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The data were used to evaluate the value of the seismic system by comparing the output with historical data sets and, eventually, to create a high-resolution image of the reservoir.

This emerging DAS method for reservoir monitoring opened new doors, and Silixa has now facilitated commercial seismic surveys in more than 60 wells. For me, personally, the TSB/Statoil collaboration was an excellent growth opportunity. My academic background had equipped me with a range of useful skills: studying mechanical engineering as an undergraduate developed my technical communication skills and gave me the confidence to oversee the building of elaborate experiments, while my postgraduate work in applied physics and acoustics taught me how to derive new concepts from first principles and conceive thorough, rigorous test programmes to evaluate ideas. During my first big project at Silixa, I added new, more business-oriented capabilities to this list. For example, I learned to manage collaborative technology development risks; facilitate meetings with senior managers from other organizations; and create publications and conference presentations related to the new capability.

### Back at the surface

Since that first seismic collaboration, I have moved into a management position and I'm now using DAS technology for flow measurement on the surface, as well as in wells. Our team has built large, customized fluid-flow measurement facilities and carried out a range of experiments to show how DAS can measure flow within pipes simply by

clamping optical cables to the pipe exterior. We have also built a test pipeline in a dry dock near Newcastle to show how DAS technology can be used to find subsea gas leaks while simultaneously monitoring for flow rate.

Most recently, we have developed a method using fibre wrapped densely on the outside of pipes to measure multiphase flow rates, and have tested this system at a variety of controlled flow test labs throughout Europe. Publishing and presenting these results to the wider technology community has been satisfying, and it has introduced me to people from across the oil and gas industry, including those working on subsea equipment development, flow measurement and in-well surveillance.

My day-to-day office tasks, though, usually involve interactions with the Silixa engineering team, our customers and sub-contractors. I get to the office at about 9 a.m. (dropping my kids off at school on the way), and we often have a team meeting soon after to check on active projects worldwide and assess progress on our cur-

rent R&D efforts. During the morning, I help review new data that were processed overnight and check on experiments that are being carried out by my team during the day.

After lunch, I often have a technical meeting with our software team, and I might participate in an experiment or review published literature relating to our work before attending an early-evening meeting with colleagues in our Houston office and customers in the US. I try to leave by 6 p.m. so that I can be home for my kids' bedtime, but if I am working on a long report or a conference publication, I will often start writing again once the kids are asleep.

If I am travelling, work becomes more hectic. When I'm in the US, for example, I try to wake up before dawn so that I can discuss things with the UK team (and avoid jet lag). Most of our collaborators in the oil and gas community are technically savvy, practically minded individuals, and they expect well-supported answers to challenging questions. As a result, customer

presentations usually require thorough advance preparation, which can often involve animated and thought-provoking discussions with my team in London. By mid-afternoon, I am generally tired. Fortunately, once the UK activity quiets down around 3 p.m. Houston time, my phone usually stops buzzing and I can work at my own pace. In the evening, I might try to meet with my colleagues for a meal, or occasionally catch a jazz concert or opera.

On the whole, the pace and volume of applied physics work at a sensing start-up can be challenging. However, developing new technologies also brings me a broad sense of existential satisfaction, particularly once an installation is complete and a customer is happy. This satisfaction continually motivates me, and has helped to give me an occupation where, thankfully, I can look forward to every new day.

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## Careers and people

### Spotlight on: Richard Boudreault



Science entrepreneur Richard Boudreault was recently awarded the Canadian Association of Physicists/Institut National d'Optique Medal for Outstanding Achievement in Applied Photonics for his "impressive career", including his role in establishing several companies based on photonics technologies.

Boudreault began his career as an astrophysicist, working on the mechanics of globular clusters and developing optical instruments for the Ritchey-Chrétien telescope at Mont Mégantic Observatory during his undergraduate studies at the Université de Montréal, Canada. From there, it was a short hop to the aerospace industry, where he worked on computational fluid dynamics for several years, earned a Master's degree in mechanical and aerospace engineering from Cornell University in 1981, and joined a start-up firm that developed instrumentation for satellites.

One of the projects he worked on in this period was a piece of software that detects and locates pilots or other individuals in distress using Doppler shifts on emergency beacons. This system is now widely used and has helped to save more than 500 lives.

After holding a string of high-level posts at various space-science firms, Boudreault moved into the advanced-materials industry in the early 2000s, developing new methods of producing high-purity alumina, which is used to make products such as LEDs, lasers and photonic crystals. He has served on the board of around 30 different organizations, a role he currently holds with Canada's Space Advisory Board, Sigma Energy Storage, Polar Knowledge Canada and Anyon Systems, a start-up that is developing a topological quantum computing system.

### Movers and shakers

**Asimina Arvanitaki** has become the first holder of a new C\$8m research chair, the Stavros Niarchos Foundation Aristarchus Chair in Theoretical Physics, at the Perimeter Institute in Waterloo, Canada. The post will support her research on the so-called "precision frontier" of particle physics, which uses table-top experiments to search for minuscule deviations in the theoretically predicted values of certain physical properties.

**Jeff Dahn**, a physicist at Dalhousie University in Halifax, Canada, who helped develop the ubiquitous lithium-ion batteries found in laptop computers and mobile phones, is among six researchers to win the Canadian government's first ever Governor General's Innovation Awards.

It's been a big month for gravitational-wave prizes, with **Ronald Drever**, **Kip Thorne** and **Rainer Weiss** receiving both the \$500,000 Gruber Cosmology Prize and a share of the \$3m Breakthrough Prize in Fundamental Physics. The trio, who played a major role in setting up the Laser Interferometer Gravitational-Wave Observatory (LIGO) and thus in the first ever detection of gravitational waves, will split \$1m of the Breakthrough Prize, with the remaining \$2m being divided equally among the 1012 LIGO contributors.

Astronomer **Jacqueline van Gorkom** of Columbia University, US, has been awarded the 2016 Karl G Jansky Lectureship for her outstanding contributions to radio astronomy.

The ultracapacitor-based energy storage and power delivery firm Maxwell Technologies has appointed a physicist, **Henning Hauenstein**, as its new vice-president for strategy and marketing.

**Mun Dae Kim** of the Korea Institute for Advanced Study has won the inaugural Howard E Brandt Best Paper Award for his work on superconducting flux qubits.

Optical scientist **Michel A G Orrit** of Leiden University, Netherlands, has won the European Physical Society's Edison Volta Prize for 2016 for his contributions to the field of single-molecule spectroscopy and imaging.