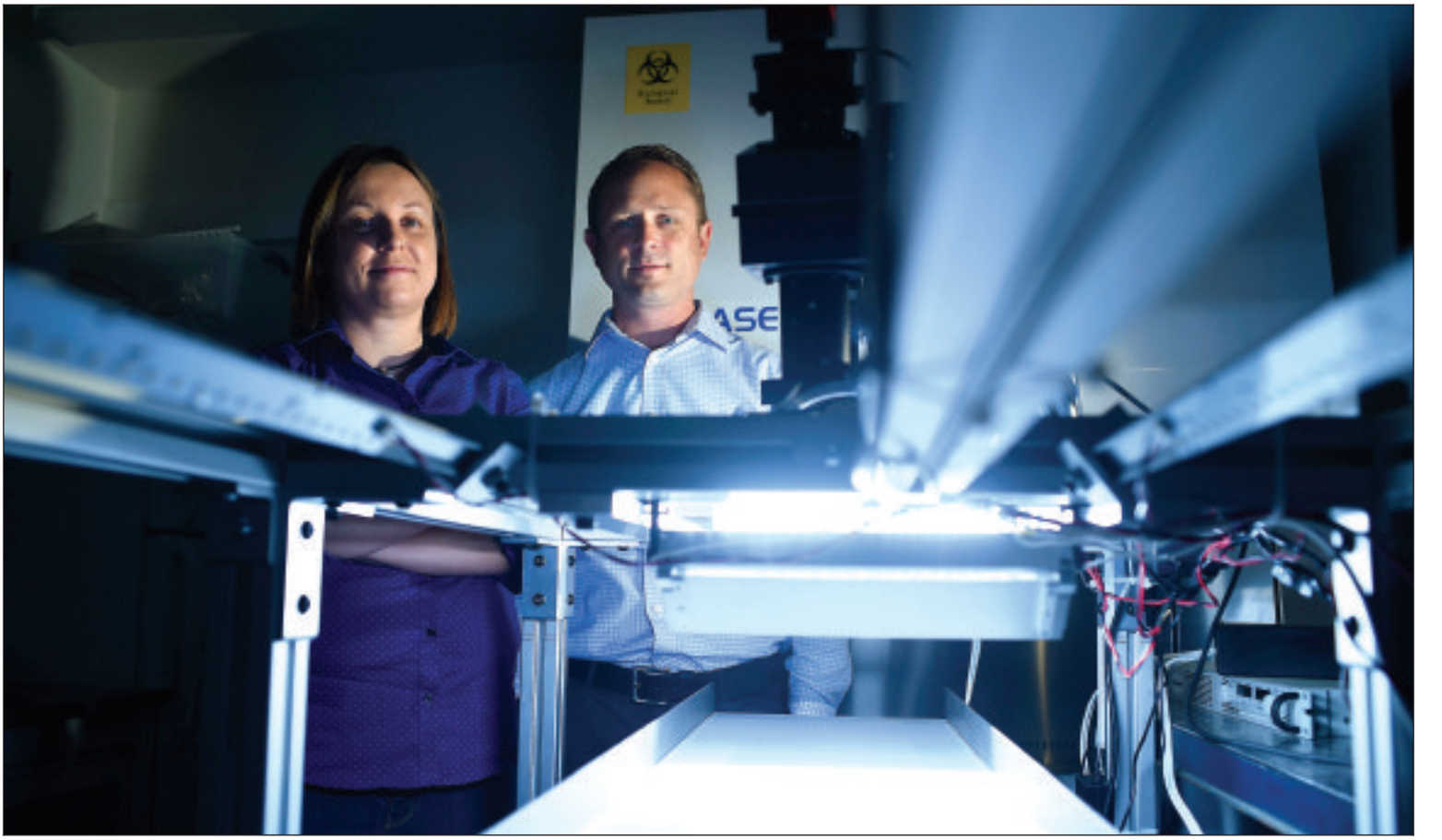

PETER LEE, RECORD STAFF

P&P Optica president Olga Pawluczyk, seen here with Kevin Turnbull, the firm's vice-president of sales, says spectroscopy is at the interesection of various disciplines, including photos, chemistry and data analysis.

Spectrometers make their mark from space to recycling

Carolyn Gruske, Special to The Record

With its spectrometers circling the Earth aboard the International Space Station, sorting plastic in a recycling facility and examining the health of early-term babies in a research hospital, P&P Optica's corporate reinvention seems to be on target.

The Waterloo-based company, which started in 1995 as an optics consulting firm, first morphed into a producer of spectrometers for scientific research. By 2010, however, Olga Pawluczyk, the firm's president, could see a place for spectroscopy in machine vision and other fields.

SEEING THINGS DIFFERENTLY

"I'm talking about this loosely," Pawluczyk says. "To me, machine vision is everything from medical imaging to industrial process control. Any time you'd use a camera to look at something, you could use a spectrometer, and get more detail."

Although the concept of spectroscopy is relatively easy to explain — it's what happens to a beam of light when it encounters an object — the science behind it is complex.

When hit with a beam of light, an object will reflect, absorb or refract the light. By analyzing exactly what happens to the light source — how much of its wavelength is split into the individual colours of the rainbow (or spectrum), for example — scientists are able to determine the exact chemical composition that makes up each object with precise detail. Depending on the type of analysis being conducted, the light source can be anything from a single-coloured laser to near infrared light to a white light that contains the full spectrum of colours.

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Pawluczyk sees spectroscopy as an intersection of many disciplines, from photonics, to chemistry, to the science of detection and illumination, to the complex world of data analysis.

"You almost have to be a one-stop shop," she says, "because your clients cannot be expected to be experts in all of these things. If they're good at imaging, they probably are likely to not be so good at interpreting the chemical composition. Over time, we've learned a lot and I think that's where our expertise is on the market. … We really do understand the problem they are facing from the chemistry side — that if you just buy a spectrometer off the shelf you are unlikely to have that level of understanding."

One of the advantages to using spectroscopy is that it's fast. It's that characteristic that earned P&P Optica its first industrial client — a recycling plant that needed to sort different types of transparent plastic. The plastic, which can be in pieces as small as one square centimetre, travels through the plant on a two-metre-wide conveyor belt moving at three metres per second. As the pieces are identified, they are diverted and grouped based on their chemical composition.

While scanning an object is relatively easy, interpreting results is a different story. Sometimes even understanding what the results should look like is a challenge.

Currently, the 17-member P&P team is involved in a project — partially funded by federal and provincial grants — to help Brantford-based produce company Ippolito Inc. more efficiently sort spinach leaves for quality and freshness.

"They have in-line technology they have been using, but it is diverting a lot of good spinach to their waste pile to the tune of almost $1 million per year of lost good product," says Kevin Turnbull, P&P Optica's vice-president of sales. "It's way over-sorting."

Pawluczyk explains that a person sorting leaves takes in a wide variety of factors, including colour, size and shape, and how limp the leaves are. A traditional machine-vision system can pretty much only see their colour. For an automated sorting system to be accurate, it must be able to go beyond that, so P&P is working with researchers at the University of Guelph to understand a bit more about the chemistry of good quality spinach.

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> P&P OPTICA PRESIDENT

By asking questions about the moisture content of top-rated leaves or the type of proteins they contain or how much chlorophyll they have, they hope to establish guidelines that will be used to interpret data collected by the spectroscopic inspections. The prototype of the system is expected to be ready by next February or March.

Spinach isn't the only food product on P&P's menu. The company is also working on meat inspection systems.

Although Pawluczyk is delighted to be working on projects for food producers — she finds the passion displayed by everybody in Canadian agribusiness compelling — the company hasn't abandoned its pure research clients. One of P&P's spectrometers is being used by the Lawson Health Research Institute in London, Ont., to check the health of premature babies.

"If the baby is born too early, its vasculature is not developed very well and they are prone to have random strokes for not much reason," says Pawluczyk. "You want to monitor these babies very carefully and a lot of monitoring techniques, like using CT scans for example, put enough stress on the baby so it is more likely to have an event happen. These people are trying to see if they can just shine light through the very thin, actually non-developed skull of a baby and see if there is any compromise on the vasculature of the brain."

Another piece of P&P Optica equipment finally made it to the International Space Station. The company's first spectrometer destined for space was lost when the SpaceX rocket carrying it exploded in 2015. The successful launch was conducted in July.

"(The spectrometer) will be looking at the sunset behind Earth from the space station and will monitor the different depths of atmosphere, and based on the spectra we see we will be able to say, 'There is more oxygen close to the surface and there is more ozone close to the end of the atmosphere,' " says Pawluczyk.

"It's more for interest and to excite people about our science, which is spectroscopy, than to do any very serious scientific investigation," she says. But she adds that Isaac Newton invented the prism and in the 1800s Joseph Ritter von Fraunhofer was looking at signatures from the sun "and here we are following Newton and Fraunhofer — that's pretty cool." ■