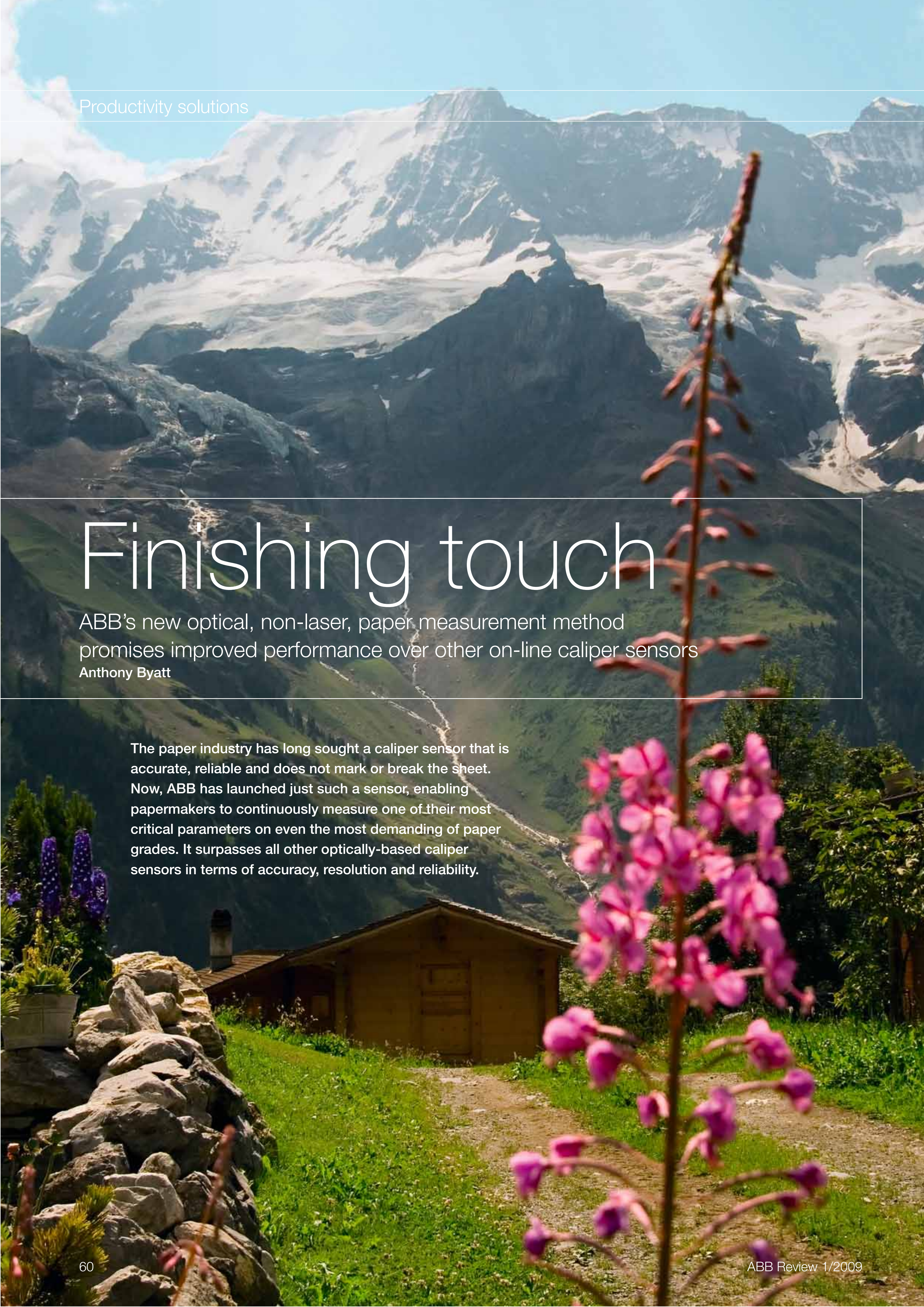


Finishing touch

ABB's new optical, non-laser, paper measurement method promises improved performance over other on-line caliper sensors

Anthony Byatt

The paper industry has long sought a caliper sensor that is accurate, reliable and does not mark or break the sheet. Now, ABB has launched just such a sensor, enabling papermakers to continuously measure one of their most critical parameters on even the most demanding of paper grades. It surpasses all other optically-based caliper sensors in terms of accuracy, resolution and reliability.

Paper "thickness" can be a misleading term as some paper grades, on a microscopic level, resemble the Swiss Alps 1. In a lab measurement of paper thickness, a standard weight lightly compresses the peaks and the residual sheet thickness is, by definition, the "caliper." Caliper is a need-to-have measurement for almost every papermaker.

In most on-line caliper sensors, the paper is "pinched" between a pair of skis. A magnetic distance sensing device in one ski measures the distance between the skis and thus provides a measurement of sheet caliper.

Paper thickness can be a misleading term as some paper grades, on a microscopic level, resemble the Swiss Alps!

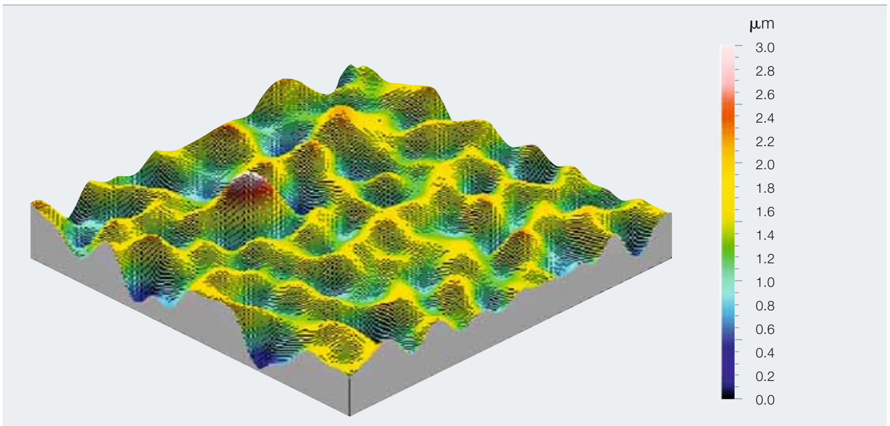
The current top-of-the-range ABB "GT" caliper sensor employs this simple principle, though years of engineering finesse have gone into refining the materials and lightening the ski's touch. In this way, a caliper accuracy of better than 1µm across a 10-meter wide sheet running at 120 km/h can be achieved! This dual sided contacting ABB sensor has become an industry standard, now utilized on more than 1,000 paper machines.

ABB's optical caliper sensor enables papermakers to continuously measure their most critical parameters on the most demanding of paper grades.

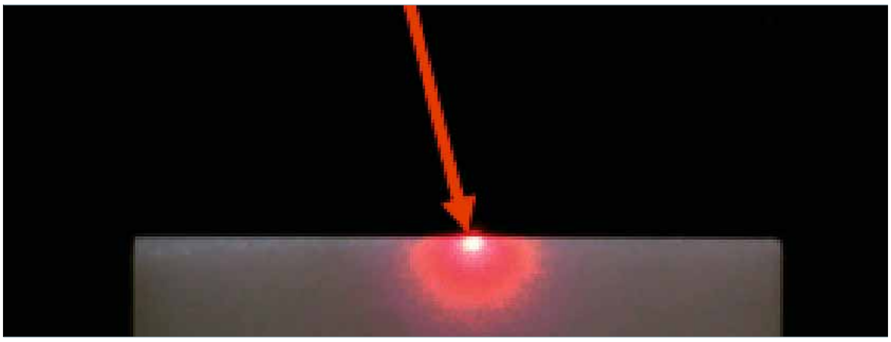
Uphill skiing

However, the touching skis can cause quality problems: coated paper can be scratched; dirt in recycled paper or non-cured coatings can build up and generate an uneven surface on the skis, thereby falsifying the reading; and lumps in the paper can come whizzing along and damage – or even

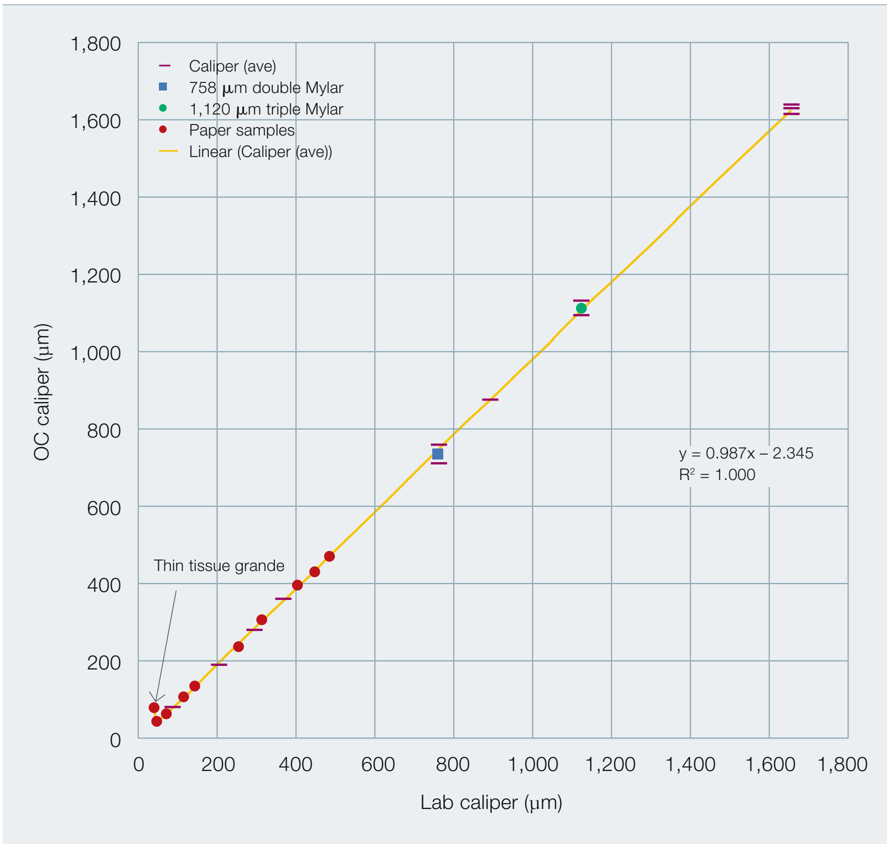
1 On a microscopic level paper resembles the Swiss Alps!



2 An illustration of the "glow-ball" effect of laser penetration into the paper surface



3 ABB's optical caliper (OC) performance versus a variety of paper grades



break – the ski or rip the paper. Of course, most paper grades do not have these problems and the sensor will function fine for years. But in those that do, the papermaker suffers a serious loss of insight into, and control of, his process.

The new ABB optical caliper (OC) sensor changes all this.

The footprint of ABB's optical caliper sensor is only 12 microns!

Look but don't pinch

The idea of measuring caliper without pinching the paper is not new. Indeed, ABB pioneered this – with air-bearing techniques – as far back as 1970. Laser triangulation methods also showed promise but are plagued by substantial errors caused by instability in a fast moving sheet, tilt effects from a non-flat sheet, sensor alignment, surface topography effects, and not least, laser light penetration into the semi-translucent paper body (ie, glow-ball effect) 2. These problems have hindered the market success of sensors based on laser triangulation. Therefore, ABB decided to assess the potential of technologies from other industries. One technique in particular caught its eye – a confocal optical inspection method.

Customer demands

An evaluation showed that this technique did indeed work. Even better, there were commercially-available optical devices which could form the core of the sensor. The optical non-laser, inspection method had been successfully proven in the lab 3, but the question remained as to how it would work on a paper mill – under harsh conditions – with high-frequency vibration signatures well outside the fine micron measurements to be measured?

The optical measurement provided better small-scale details of the machine variability 4. A contacting sensor ski has a footprint of some 1 to 2 cm, while that of the optical sensor is only 12 microns!

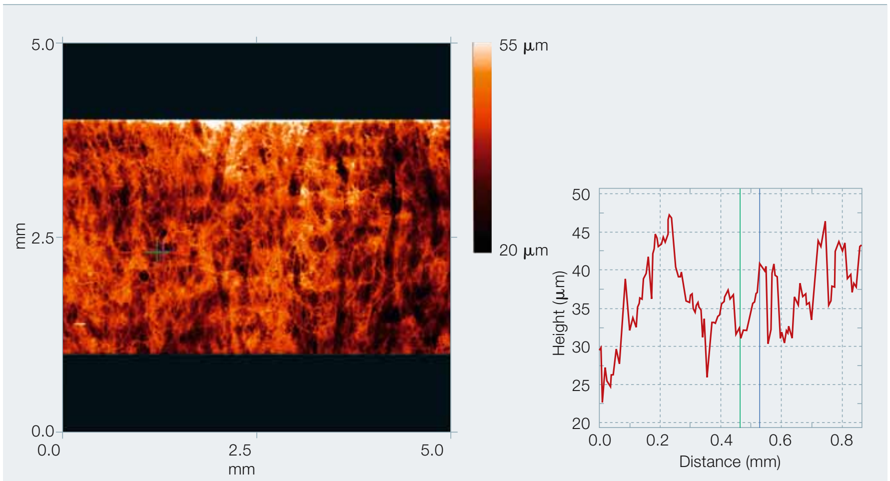
The optical caliper sensor surpasses all other optical-based caliper sensors in terms of accuracy, resolution and reliability.

From prototype to product

Much work was needed to productize and optimize the sensor. The old saying of "5 percent inspiration, 95 percent perspiration" came into its own with a vengeance! One major challenge was to preserve the micron accuracy on a large steel structure that heats up from room temperature to 80°C with all the attendant thermal expansions!

The product was launched in March at the ABB sponsored conference "Automation and Power World 2009" in Orlando, Florida. An article discussing the sensor in greater detail will appear in a future issue of *ABB Review*.

4 High-resolution surface profiles of 80 gsm copy paper viewed by optical caliper inspection technology



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