Environment, power and size

On 8 April 2009, the FHI trade association for industrial electronics, in collaboration with the Dutch Technology Foundation STW, organized Sense of Contact 11. The goal was to show the potential of sensors to solve current issues and challenges. This eleventh edition of the sensor technology workshop, in Zeist in the centre of the Netherlands, focussed on three issues: environment, power and size. Dutch universities, institutes and industry presented their recent sensor (and actuator) research and development results pertaining to these three challenges.

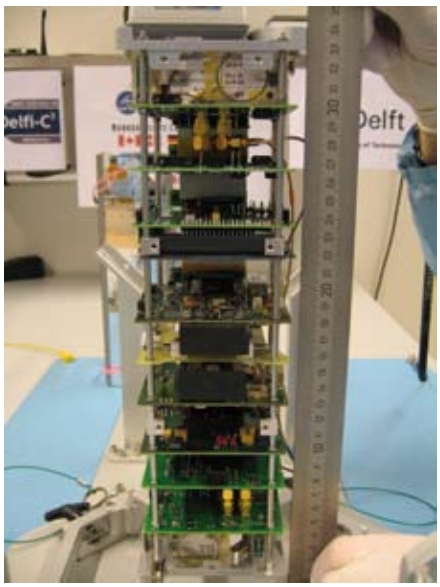
• *Joris Gonggrijp and Hans van Eerden* •

As an 'appetizer', Frank Linde of Nikhef (the Dutch National Institute for Subatomic Physics) gave a presentation on the world's largest 'scientific istrument' equipped with giant sensors, the Large Hadron Collider at CERN (Geneva). Later this year, experiments will start to register head-on collisions of protons with energies up to 7,000,000,000,000 eV. At these unprecedented energies physicists hope to observe new phenomena, like: the Higgs particle (assumed to be responsible for the concept of mass in our universe); supersymmetric particles (the lightest of which could explain the nature of dark matter in our universe); and mini black holes (pointing at the existence of extra spatial dimensions in our universe). Any of these will revolutionize our view of the world we live in.

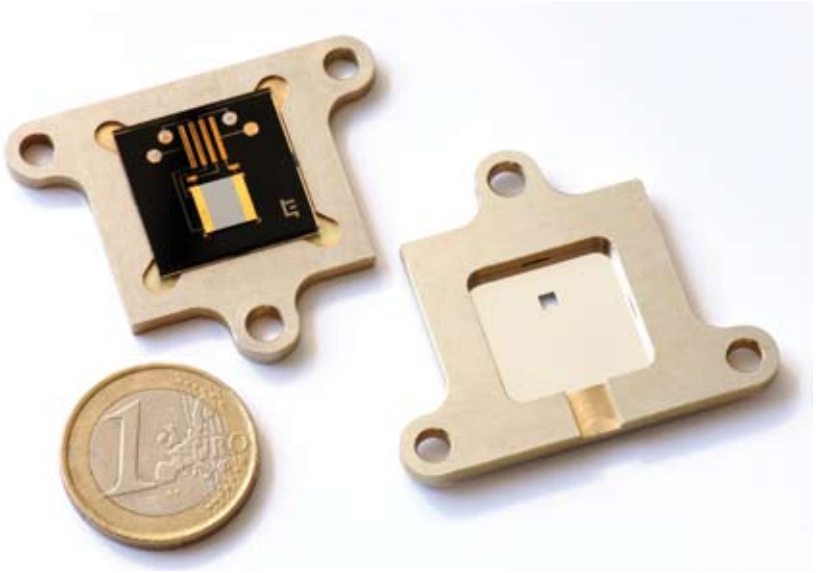
Micro

The rest of the day was filled with parallell sesions, and closed in a plenary session by Han Gardeniers from the University of Twente, on microfluidic sensors. State-of-the-art microfluidic technology allows precise handling of nanolitre to microlitre fluid volumes, in microsystems with integrated sensing elements. This enables in-situ studies of biological and chemical processes with minimal sample consumption and high spatial resolution. The presentation demonstrated the need for microsensors, and thus underlined size as an issue in sensor technology.

One of LHC's 'sensors', the giant CMS detector. (Photo: CERN)



The interior of the Delfi C³ satellite, which was launched last year in India.



Both sides of a sun sensor designed by TNO Science & Industry. (Photo: TNO/Fred Kamphues)

Related contributions came from University of Twente spin-offs Micronit and Kryoz Technologies, on microreactors used in research and industrial production, and micro cryogenic cooling systems, respectively.

Space

Sensor size is also an issue in space, where the mass (and therefore the size) of the payload of satellites and spacecrafts has to be reduced as much as possible, to minimize energy/fuel consumption and extend operational lifetime. Chris Verhoeven from Delft University of Technology presented the case of so-called CubeSats, of which the recently launched Delfi-C³ satellite is a good example. This 2.2 kg CubeSat, constructed by Delft students and staff, carries a payload including thin-film solar cells (Dutch Space) and an autonomous wireless sun sensor (TNO). According to Verhoeven, CubeSats may be the heralds of a new way of space mission design. Exploiting modern microelectronics and microsystems, colonies of small spacecraft seem to become a challenging but feasible option.

Environment

More extensively, sun sensors were discussed by Johan Leijtens of TNO Science and Industry, focussing on their design and qualification for space travel. Here, the environment (during the launch and in space) is a prime design determinant. In reducing the sensor size, power supply, data handling, manufacturability and integrated packaging have to be considered. Sun sensors may find various applications in space (satellite altitude control, solar power generation) as well as down on earth, for example in domotics (home automation) and airconditioning control in cars.

Sensor networks may be used, for example, to monitor the environment, to gain insight in complex phenomena such as global warming. Environment-related sensor applications are also found in (sustainable) energy. The Dutch energy research institute ECN, for example, conducts sensor research for fuell cell technology and smart gas meters.

Power

Another current issue in sensor technology is power. Energy harvesting is an option for powering autonomous (wireless) sensor systems that can serve many domains for an ambient intelligent future (e.g. body area networks for medical applications, ‘smart buildings’, automotive, predictive maintenance). True autonomy can only be achieved using energy harvesting, i.e. taking up (e.g. photovoltaic, vibration, thermal or radio-frequency) energy from the environment. Ruud Vullers of the Eindhoven-based Holst Centre discussed principles of energy harvesting, recent results and challenges, and gave an outlook. Micromachining, he concluded, will be the key to mass application of energy harvesters.

Authors’ note

Joris Gonggrijp is former director of LiS (Leiden instrument makers School) and former DSPE board member. Hans van Eerden is editor of Mikroniek.

Information

www.fhi.nl/senseofcontact