# Challenge description

<table>
<thead>
<tr>
<th>Challenge name</th>
<th>2D Optical Pressure Sensor</th>
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<tbody>
<tr>
<td>Challenge owner</td>
<td>TU/e</td>
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<tr>
<td>henrie van den boom</td>
<td>Henrie van den Boom</td>
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<tr>
<td>Email challenge owner</td>
<td><a href="mailto:h.p.a.v.d.boom@tue.nl">h.p.a.v.d.boom@tue.nl</a></td>
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<tr>
<td>Phone challenge owner</td>
<td>+31(0)40 2473444</td>
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<td>CoC Number</td>
<td></td>
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<tr>
<td>Preferred way to contact</td>
<td>email  Phone call  SMS / what’s app</td>
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<tr>
<td>Account manager</td>
<td>Matthijs Bulsink</td>
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<td>Brief summary</td>
<td>Recently, a pressure sensor technique that uses optical power cross-coupling was developed. At the intersections of crossing polymer optical fibres the locally applied pressure can be detected. This principle can for example be applied to monitor movements, breathing and heartbeat of a person lying on a mattress in a home environment, unobtrusively.</td>
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About the challenge owner

Henrie van den Boom is an Assistant Professor in Electro-Optical Communication Systems at Eindhoven University of Technology. His areas of expertise include Electrical Engineering, Communication Engineering and Electronic Engineering. Currently, his research is focused on radio over fiber and novel optical sensor systems and applications, using Plastic Optical Fibres. Plastic optical fibre (POF), also referred to as Polymer optical fibre, offers several practical benefits.

Problem definition

We recently developed and patented (WO2017144675A1) a system that uses optical power cross-coupling at the intersections of crossing ductile plastic optical fibres to estimate the amount of locally applied pressure. The cross-coupling occurs due to the scattering of light between two plastic optical fibres placed perpendicularly on top of each other. Using a grid of crossing fibres, highly-sensitive two-dimensional pressure measurements can be realised. Plastic optical fibres are cheap and can be easily woven/attached to a piece of fabric to create a portable and flexible sensor of any size. Such a sensor can, for example, be placed underneath a normal home mattress to monitor movements as well as breathing and heartbeat of patients. As it does not rely on electrical sensing methods, it is not susceptible for potentially disturbing electromagnetic radiation (e.g., from WiFi) nor can it cause interference with e.g. sensitive medical equipment in a hospital environment.

Desired Outcome

The desired outcome is a viable, feasible and desirable prototype around this technology.

NOTE: Applications around sleep apnea in (hospital) beds and around pain from the wrong sleeping position in bed are excluded.

Input and involvement of project owner

Resources we make available for this project:

- Coaching sessions.
- Materials that can be used to prototype.
- Financial resources to buy materials.
- Contact details of important stakeholders in our network.
- Equipment that can be used to prototype.
- TU/e Experts
Cross-Disciplinary Research themes

The table below describes the six research themes present at the TU/e. We would like to know to what research theme this challenge contributes.

<table>
<thead>
<tr>
<th>Research Theme</th>
<th>Description</th>
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<tbody>
<tr>
<td>Smart Materials &amp; Processes</td>
<td>Adaptive, responsive, self-healing, bio-inspired, atomic-scale-controlled, advanced catalytic and other smart materials &amp; processes will provide new opportunities in health care, energy, the built environment, mobility, the high-tech industry and more.</td>
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<tr>
<td>Complex High Tech Systems</td>
<td>High-tech systems are relevant at different levels of scale. Both complex products and complete cities can be seen as high-tech systems. The focus is on the interfaces between high-tech systems, data science, smart materials, software engineering and artificial intelligence.</td>
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<td>Bioengineering Health</td>
<td>Examples are regenerative medicine, personalized medicine, monitoring systems that keep track of a person’s health, health-stimulating environments, diagnoses based on imaging and sensor techniques, new treatments using robotics and minimally invasive techniques, new rehabilitation processes and new health care services processes.</td>
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<tr>
<td>Renewable Energy</td>
<td>A focus on future fuels, renewable energy generation, new energy storage technology, reducing energy needs, energy systems and the energy transition itself. Solar fuels, solar and wind energy, clean combustion, catalysis, energy reduction, energy materials, smart grids and energy governance and societal dynamics regarding energy.</td>
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<td>Human-centered Systems and Environments</td>
<td>The focus on technologies that are bound to change the human environment significantly, such as artificial intelligence, human technology interaction, new design principles and advanced materials. This knowledge can be applied in areas like smart cities, mobility and sports &amp; vitality.</td>
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<td>Data-driven Intelligent Systems</td>
<td>New ways of computing and data processing are needed to analyse the avalanche of data we will all collect in the future. A strong focus in data science, software science, telecommunications, cryptology and ethics-related research. By exploring opportunities related to artificial intelligence, smart cities, cybersecurity, hardware-software integration and modelling.</td>
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Role of different disciplines (only for ISBEP)

The table below describes what different disciplines of students could be doing. It is free for teams and individual students to define his/her own goals and outcomes.

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Suggested</th>
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<tbody>
<tr>
<td>Architecture, Urbanism and Building Sciences</td>
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<tr>
<td>Biomedical Engineering</td>
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<tr>
<td>Medical Sciences and Engineering</td>
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<tr>
<td>Automotive</td>
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<tr>
<td>Electrical Engineering</td>
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<tr>
<td>Industrial Design</td>
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<tr>
<td>Psychology &amp; Technology</td>
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<tr>
<td>Sustainable Innovation</td>
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<tr>
<td>Industrial Engineering</td>
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<tr>
<td>Chemical Engineering and Chemistry</td>
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<tr>
<td>Applied Physics</td>
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<tr>
<td>Mechanical Engineering</td>
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<tr>
<td>Computer Science and Engineering B</td>
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<tr>
<td>Data Science</td>
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<tr>
<td>Software Science</td>
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<tr>
<td>Applied Mathematics</td>
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<tr>
<td>Web Science</td>
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