Institute of Mechanical Sciences and Industrial Applications (IMSIA),
Tutelle ENSTA Paris, CNRS, CEA UMR 9219

FibsDip

#MedTech #Sensors #FBGs

THE PROBLEM ADDRESSED

Although technical solutions exist to aid patients and restore their mobility, clinical complications are frequent, and too many patients still give up using prostheses.

Prosthetists, on the front line in this care, lack precise indicators and are required to review their patients several times before determining an acceptable solution. They have highlighted real difficulties in determining, quickly and reliably, the most critical areas for patients (pain, friction).

The difficulties, therefore, remain for prosthetists who must base themselves on the patients' feelings to adapt the sockets.

Fiber Bragg gratings (FBGs) are sensors on optical fibers that accurately measure pressure and shear. By integrating these FBGs into a pressure patch and strategically placing it, pressure points can be precisely identified, enabling the prosthesis to be optimally customized to the individual.

TECHNOLOGY

- The device consists of a patch with optical fiber integrating FBGs as sensors, allowing to measure the distribution of pressures in different areas, without hindering the patient's movements.
- Bragg Gratings enable precise estimation of pressures and shears.
- Different geometries of sensors integrating a different number of sensors have already been tested.

COMPETITIVE ADVANTAGES

- Pressure measurements with precision, accuracy and repeatability at the interface between the liner and the socket, during walking for lower limb amputees.
- A connected, robust, non-invasive, small, easy-to-use device, allowing it to be positioned without disturbing the use of prostheses.
- A device adaptable to different parts of the body, patient populations and pathologies.

APPLICATIONS

- For the design, selection and fabrication of external orthopedic devices in different hospitals, rehabilitation centers and orthopedic companies.
- To help prosthetists in the selection and adaptation of different prostheses.

DEVELOPMENT STATUS

- TRL 3, Proof-of-Concept with prototype ongoing in patients with lower limb amputations.
- The team has already developed a prototype pressure sensor for lower limb socket that has been laboratory tested.

INVENTORS & CONTACTS

- Jean-françois Semblat, Professor at ENSTA Paris, Head of the Department of Mechanics & Energetics
  jean-francois.semblat@ensta-paris.fr
- Fabien Szmytka, Professor at ENSTA Paris
  fabien.szmytka@ensta-paris.fr
- Élodie Doyen, Research engineer at ENSTA Paris,
  elodie.doyen@ensta-paris.fr
- TTO: Julie Dion,
  julie.dion@ensta-paris.fr

PUBLICATIONS

- Szmytka F., Semblat J.F., Doyen E. (2023). *Paralympiques : comment optimiser les lames de saut pour les athlètes amputés ?*, Polytechnique Insights.
- Doyen E., Szmytka F., Semblat J.F. (2023). *A novel characterisation protocol of mechanical interactions between the ground and a tibial prosthesis for long jump,* Scientific Reports, v.13, 5226.

LOOKING FOR

- Expending to new use cases
- Co-development partners