Doctoral candidate 9: 4D printed magnetic materials in fast-responsive, wireless and remote-control shape morphing devices

Host Institution	Delft University of Technology
PhD enrolment	Delft University of Technology
Primary Supervisor	Dr. Sepideh Ghodrat
Subject area	Shape morphing materials and smart systems

About this doctoral project and your tasks

You will design, manufacture, test and validate two smart material systems/demonstrators: (i) a catheter for invasive surgery with shape and property morphing and (ii) an assistive tool to navigate and guide visually impaired people. You will (i) select appropriate materials for the intended applications, (ii) by 3D printing fabricate smart material systems with magnetic shape memory materials as active components, (iii) study the effect of a number of parameters (related both to the magnetic material and the printing process) on the shape-morphing behaviour so as to obtain the optimum combination of material and manufacturing process. (iv) The results of these tests are employed to draw up a set of design guidelines that can be used by designers. The level of technological readiness of these smart materials is still low, which makes their integration in a smart material system with various segments a challenging design assignment. Therefore, it needs elaborative testing and characterisation (developing of testing procedures). The ultimate goal is to prototype demonstrators which are responsive in a magnetic field with fast response and remote control so as to demonstrate how the appropriate integration of smart components in the structure enhances the operational functionality, taking into account a complex series of boundary conditions (base functionality, reliability, processability and user experience).

Your tasks will include :

- Systematic selection of smart materials tailored to specific applications
- Designing, manufacturing, assembling, and architecting smart material systems, resulting in two functional demonstrators
- Rigorous performance evaluation under various conditions, including static and dynamic characterization

Foreseen secondments

For this project, we foresee secondments to:

- **Dr. S. Wilson** (6 months) at Sophion (Denmark)
- **Dr. R. Mokso** (4 months) at Technical University Denmark (Denmark)
- **Dr. W. Twengstrom** (3 months) at Excillum (Sweden)

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