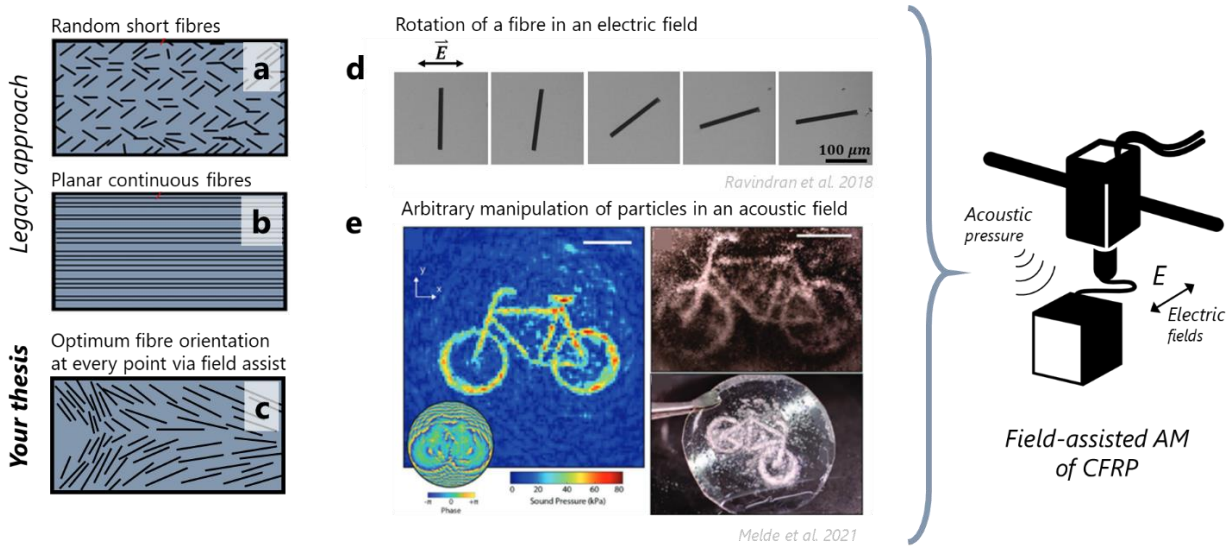
Faculty of Aerospace Engineering
Deptartment of Structures and Materials

BSc/MSc thesis, semester project or internship opportunity

‘Magic 3D printing’ – Orienting carbon fibres with electric/ acoustic fields during additive manufacturing

The exceptional properties of CFRPs are still largely inaccessible to additively manufactured (AM) components. Various approaches exist, such as using randomly oriented, very short fibres (a) or extruding continuous fibres (b). These approaches have the drawbacks of poor mechanical performance and the fibre orientation being restrained to two dimensions, respectively.

A method to orient fibres in continuously changing, arbitrary directions throughout a 3D printed part does not currently exist. This is desirable, as it would allow the fibres to be oriented optimally with respect to the stress state at every point throughout the component (c). This project works towards developing this capability. It has been shown that electric (d) and acoustic (e) fields can effectively orient, manipulate and even levitate fibres and particles. We wish to understand how these fields can be integrated into additive manufacturing, and to build a protype field-assisted AM device.



Here are some example research questions that could be formulated for your thesis:

…how do different electrode topologies (plates, combs, tip electrodes) differ in their effect?
…how does the presence of a carrier liquid influence the fibres? What are the effects of its rheology?
…what field strength is required, what degree of orientation can be achieved?
…what is the theoretical framework for fibre orientation? What are the dominant physical forces controlling the response of fibres to the fields? How can the fibre orientation be frozen?
…how do fibres respond to acoustic radiation force? Does it make more sense to use transducer arrays or acoustic lenses? …etc.

Requirements:

This project is at the intersection of mechanical and electrical engineering as well as materials science. It will be very exploratory and hands-on, as it will give you the opportunity you to design, manufacture and evaluate your own fibre orientation setups. In the best case, you have some experience with 3D printing, coding, image analysis and electronics as well as an interest in materials science. We can of course tailor the exact project requirements based on your profile. If you’re interested, send an email to: **c.lankhof@tudelft.nl** and read about our group at **shapingmatterlab.com**