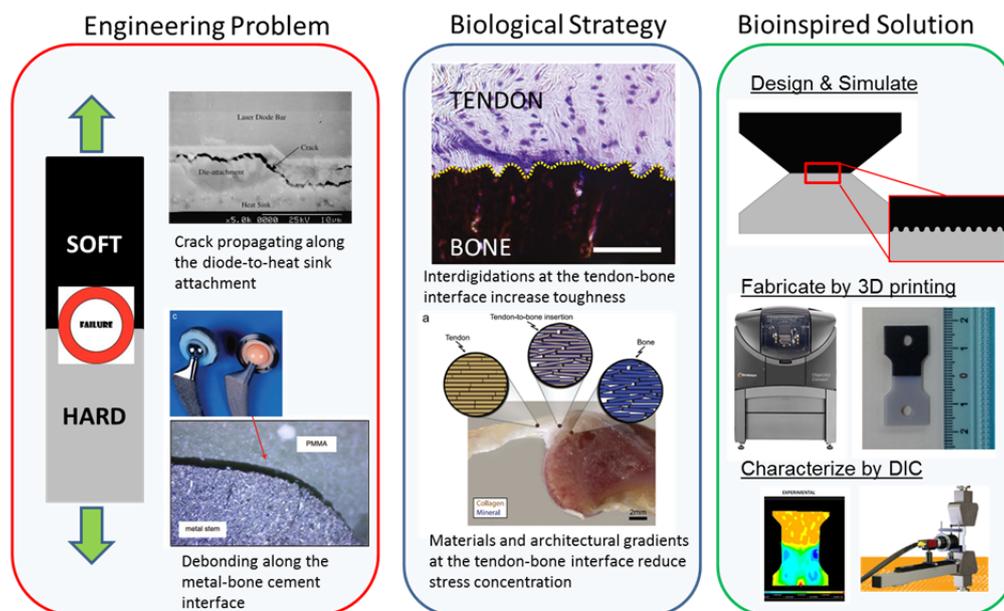


How to connect a soft material to a rigid one? A lesson from nature

Joining materials of very different properties is a frequent requirement in engineering as well as in load-bearing biological systems. Designing strong interfaces between highly dissimilar materials is a very challenging task since such interfaces are prone to stress concentration and failure [1]. Nevertheless, nature has found different solutions to avoid stress concentration at the interfaces between highly dissimilar materials including a gradual change in material properties and the presence of interdigitations at the interface [2].

The main aim of this Master Thesis is to investigate new strategies to join soft to hard materials based on the different solutions found in nature. The specific steps of the thesis are: 1) to design and fabricate proper bimaterial samples triggering failure at the interface 2) to introduce different bioinspired strategies at the interfaces to mitigate stress concentration and failure and 3) to characterize the behavior of the fabricated samples. The samples will be manufactured by a state of the art multimaterial 3D polymer printer (Objet260 Connex2, Stratasys, Israel) and the experimental characterization will include optical microscopy, mechanical testing and digital image correlation (DIC). The possible outcome of the project will be a novel design to improve engineering attachment of dissimilar materials.



MAIN TASKS

- Review the relevant literature on material interfaces
- Design and fabricate bimaterial samples
- Perform mechanical testing combined with digital image correlation
- Write a detailed report and prepare a presentation of the work performed

PRACTICAL INFORMATION

- Project type: 80% experimental, 20% computational / data analysis
- Project location: Department of Aerospace and Mechanical Engineering; Building B52/3
- Project supervisor: Prof. Davide Ruffoni, Laura Zorzetto, PhD student
- Required background: no previous knowledge but creativity and curiosity

REFERENCES

1. Dunlop, J.W.C., R. Weinkamer, and P. Fratzl, *Artful interfaces within biological materials*. *Materials Today*, 2011. **14**(3): p. 70-78.
2. Hu, Y.Z., et al., *Stochastic Interdigitation as a Toughening Mechanism at the Interface between Tendon and Bone*. *Biophysical Journal*, 2015. **108**(2): p. 431-437.