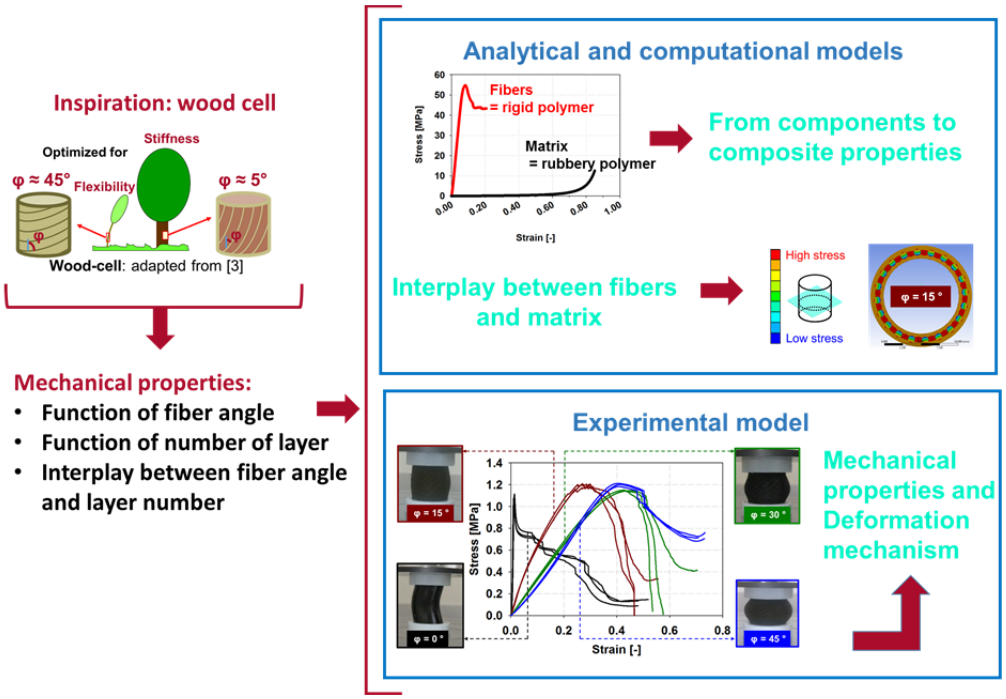
Bioinspired Helicoidal Composites with Tunable Mechanical Behavior by 3-Dimensional Multi-material Printing

The construction principle of arranging stiff helicoidal fibers into a soft matrix is used by nature both to tune the mechanical behavior of biological load-bearing materials and to achieve high-performance biocomposites starting from relatively weak components [1]. Common examples of helicoidal reinforcement are the arrangement of lamellar bone in osteons [2] and the twisted pattern of cellulose microfibrils inside the wood cell walls [3]. Therefore, the aim if this project is the characterization of cylindrical shells reinforced with helicoidal fibers fabricated by 3-dimensional polymer printing and the study of properties that can be achieved by varying the fiber angle.



MAIN TASKS

- Review the relevant literature on helicoidal composites
- Get familiar with the existing models describing mechanical behavior helicoidal composites
- Characterize the behavior of different structure as function of fiber angle.
- Write a detailed report and prepare a presentation of the work performed

PRACTICAL INFORMATION

- Project type: 50% experimental; 50% computational / analytical modeling / data analysis
- Project supervisor: Prof. Davide Ruffoni, Laura Zorzetto, PhD student
- Required background: some previous knowledge of Matlab and/or finite element analysis would be beneficial

REFERENCES

1. A.R. Studart, Adv. Funct. Mater. 2013, 23, 4423.
2. W. Wagermaier, H.S. Gupta, a Gourrier, M. Burghammer, P. Roschger, P. Fratzl, Biointerphases 2006, 1, 1.
3. P. Fratzl, R. Weinkamer, Prog. Mater. Sci. 2007, 52, 1263.

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