Several internships, PhD and postdocs opportunities about Crack propagation in Anisotropic Materials manufactured by Fused Filament Fabrication processes

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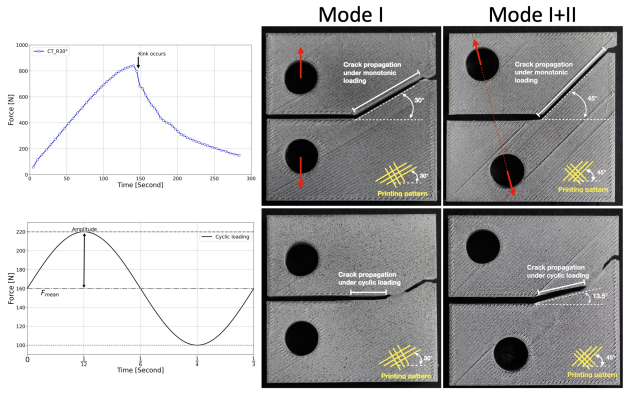

Scientific context: Due to the directional building process, additive manufacturing generally leads to anisotropic microstructures that highly influence crack propagation paths. It is thus crucial to be able to take this directionality into account in damage tolerance approaches. This is even essential to extend the use of additive manufacturing to sensitive components, for instance, in the field of aeronautics or aerospace where catastrophic failure has to be avoided at all costs. Benefits are expected in term of safety but also of carbon footprint reduction.

Several funded projects targeting this long term goal are currently in progress in our team. State-of-the-art experimental and numerical methods, together with an interdisciplinary mechanics-physics point of view, are geared toward (o) a better understanding of crack propagation in Fused Filament Fabrication processes in relation with the printing process, (i) a deep and multi-scale understanding of the physical phenomena at play, and (ii) the development of safe, experimentally validated, mechanical methods to accurately predict crack propagation from fatigue to the brittle fracture threshold. The methodology involves advanced and innovative tools, notably fracture experiments instrumented by Digital and Volume Image Correlation [1, 2] in conjunction with variational phase-field simulations of the crack advance [3, 4, 5].

We have funding possibilities for internships, 2 PhDs positions and 2 years of postdocs. Please contact us if you would like to join us. Together, we can design the position to match your skills and motivations, ranging from purely experimental projects to purely theoretical and numerical projects, or at the interface between the two.

Collaborations: LMPS/ENS Paris Saclay, CIRCS/Northeastern university Boston

Candidate profile: Master 2 level student in physics, material or mechanical engineering. Some knowledge in fracture mechanics and a taste for in-depth physical understanding will be appreciated.

Funding: ANR 3FAM or CIEDS FracAddi

Application procedure: Candidates should send M1 and M2 (when available) level transcripts and a resume to veronique.lazarus@ensta-paris.fr.

References

[1] Thomas Corre and Véronique Lazarus. Kinked crack paths in polycarbonate samples printed by fused deposition modelling using criss-cross patterns. *International Journal of Fracture*, 230(1):19–31, July 2021.

[2] Haizhou Liu and François Hild. Quantifying 3d crack propagation in nodular graphite cast iron using advanced digital volume correlation and x-ray computed tomography. *Engineering Fracture Mechanics*, 296:109824, 2024.

[3] Bin Li and Corrado Maurini. Crack kinking in a variational phase-field model of brittle fracture with strongly anisotropic surface energy. *Journal of the Mechanics and Physics of Solids*, 125:502 – 522, 2019.

[4] Benjamin E. Grossman-Ponemon, Ataollah Mesgarnejad, and Alain Karma. Phase-field modeling of continuous fatigue via toughness degradation. *Engineering Fracture Mechanics*, 264:108255, 2022.

[5] Xinyuan Zhai, Thomas Corre, Ataollah Mesgarnejad, Alain Karma, and Veronique Lazarus. Path differences between quasistatic and fatigue cracks in anisotropic media. *https://arxiv.org/abs/2404.08451*, 2024.