

## 3D-printed continuous and short carbon fibre reinforced composite metamaterials with tailorable negative Poisson's ratios

### Abstract


Currently, metamaterials have been attracting increasing attention with a wide range of applications, i.e., smart materials, graded materials, shape memory alloys, biomaterials, etc. This study developed an integrated computational design method with 3D printing to endow continuous and short carbon fibre reinforced composite metamaterials with negative Poisson's ratios. First, continuous carbon fibre (CCF) composites were designed using a multidisciplinary technique integrating homogenisation-based topology optimisation and fibre placement methodology for determining the 3D printing set-up with fused filament fabrication. Second, specimens made of pure polyamide (PA), short carbon fibre reinforced PA (SCF/PA) and CCF reinforced PA (CCF/PA) were fabricated and tested for a comparative evaluation. Lastly, the effects of carbon fibre reinforcement were investigated, showing that a small addition of CCFs (vol% = 0.23) can improve the negative Poisson's ratio from  $-0.24$  of the PA metamaterials to  $-0.34$ . However, other greater CCF volume fraction would reduce the negative Poisson's ratio

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### Biography

Dr. Yuan Chen is currently undertaking a Research Fellow position as ARC Postdoctoral Research Associate in the University of Sydney. He obtained his PhD from the University of Sydney in 2019. His research interests are concentrated on additive manufacturing of composite materials, design and computational analysis of composite structures, topological and structural optimisation for metamaterials and advanced composites. Due to his achievements, he has been

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