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Re-programmable sequential folding/unfolding in 3D printed structures

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Sequentially controlled folding/unfolding (or shape morphing) has been a hot research topic for a number of years. Given the additional feature of shape switching, 3D printing can be naturally extended to 4D printing, so that the application area of 3D printed structures can be significantly widened. In technical terms, there are four basic approaches to achieve 4D printing, but so far to realize sequentially pre-determined morphing in 3D printed sophisticated structures is still a challenge. In this paper, by means of integration of two separately well explored concepts, namely, multiple stable structure and compliant mechanism, we demonstrate how to achieve sequentially controlled morphing in 3D printed structures. More importantly, we show that, the morphing sequence of the 3D printed structures not only can be determined in the early design stage before the structures have been 3D printed, but also can be re-programmed in the later on stage after the structures have actually been printed utilizing the shape memory effect to fix the structures into a new shape. Since the heat/chemo-responsive shape memory effect has been proved to be an intrinsic feature of most polymeric materials, re-programmable sequential folding/unfolding can be easily realized in 3D printed polymeric structures by design.

Biography

Wei Min Huang completed his PhD at Cambridge University, UK. After that, he joined the School of Mechanical and Aerospace Engineering, Nanyang Technological University, Singapore. He has over 20 years of experience on Shape Memory Materials and Technology and has published research articles extensively in this field, including two books about shape memory alloys and shape memory polymers, respectively. His research interest in 3D printing is actually focused on 4D features, in particular to achieve re-programmable sequential folding/unfolding of 3D printed structures via the shape memory effect.

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