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R. Delbart[1], C. Robert[2], T.Quynh Truong Hoang[3] and F. Martinez-Hergueta[1]

[1]School of Engineering, Institute for Infrastructure and Environment, University of Edinburgh, UK
[2]School of Engineering, Institute for Materials and Processes, University of Edinburgh, UK
[3]ESTACA, Pôle Mécanique des Structures Composites et Environnement, Ecole d'ingénieurs, France

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3D printing has become a widespread technology to manufacture complex geometries [1]. There are numerous methods that allow to implement the 3D printing process [2]. Among them Fused Deposition Modelling (FDM) is a common technique using filaments made by different materials such as thermoplastic, metal, wood or composite [3]. The combination of different materials inside a 3D printed device can give us the ability to program a particular area of a device and be able to activate it through heat, water, chemical reaction, pressure and many other external influences. The self bending actuator is formed by a conductive dual polymer in which one component remains elastic and the other presents variable stiffness depending on the applied temperature, resulting in a reversible switch [4]. As the actuator is warmed by an external source, the main drawback of this approach is the difficulty to control the temperature along large structures. The response will also vary with the ambient temperature. The emergence of conductive filaments made of carbon particles reinforced thermoplastic allows to print integrated electrical circuits on 3D parts. These conductive filaments permit us to self-heat by Joule's effect a specific area of the 4D printed actuator and supress the main drawback.

In this investigation we have developped a 4D printed actuator with an integrated temperature controlled triggering system. The actuation is possible thanks to some programming steps: (a) Self-heat the actuator above the glass transition temperature (Tg). (b) Stretch the actuator while above Tg. (c) Cool the actuator below Tg while holding the displacement & (d) release the displacement. We have studied the influence of the programming steps parameters on the actuation. After the programming steps, the 4D printed actuator is bending and recovering to return to its initial position. Results show that the different programming steps parameters strongly influence the speed and amplitude of the bending and recovering of the actuator and offer a variety of design-based strategies for self deployable actuators

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