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The adaptive properties of a shape memory composite

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The present research program has studied the morphing properties of a shape memory composite (SMC) constituted by an array of shape memory alloys (SMAs) based Nitinol tubes, embedded in a shape memory polyurethane matrix. In this study, the Nitinol tubes were subjected to a two-way shape memory effect (SME) process, in order to control the actuation properties of the smart composite. It has been observed that the two ways trained SMA tubes successfully induced a morphing performance on the composite following a heating-cooling process. The initial results suggest that the actuation behavior of the SMC strongly depends on the tubular fluid heating rate, as well as on the temperature difference between the glass transition temperature of the matrix and the activation temperate of the alloy. Finite Element (FE) Analysis on the tubular composite has also been performed. The thermo-mechanical actuation model appears to successfully simulate the morphing performance of the adaptive composite. The FE analysis showed that the temperature profile in the SMC exhibits an exponential decay along the width axis during the heating-cooling cycle, which induces some degree of restriction on the full deformation of the composite. The model suggests that a linear tubular arrangement with spacing in the range of three millimeters would yield a uniform temperature distribution along the width and thickness of the SMC. The current study provides the elementary design parameters for future developments of morphing structures based on tubular shape memory composites.

Biography

P Cortes is an Assistant Professor in the Chemical Engineering Program at Youngstown State University. His PhD is in Materials Science and Engineering and his areas of interest are: composite materials, smart structures, additive manufacturing and sensors. He has published several papers in reputed journals in the area of mechanics, composite structures and adaptive materials.

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