4-D Printing: Creating Tessellated Foldable Structures, Year III

Havel, Morgan

3-D printing allows for the creation of items in computer design programs and proceed to print them immediately. A new concept of 4-D printing has emerged that allows people to create objects using material that can change form in certain environments, such as objects that can be folded to minimize space requirements, by using unique shape memory material, it allows them to unfold without assistance, into larger, usable structures. Can a foldable, tessellated bridge be designed and built that can self-assemble? Since Shape Memory Polymer materials are not readily available, other materials can be used to simulate self-assembly by requiring only minimum amounts of force to fold and unfold a well-designed tessellated bridge. Multiple tests were executed to test the bridge design using a force sensor, motor, accelerometer, and different connecting materials. Test 1 measured force to close the bridge when connected using different materials. The paracord required the least amount of force in the test. Test 2 measured the force to open the bridge. Triangle 3 required the least amount of force in the test. Test 3, the materials tested for elasticity were unable to stretch to the required amount needed to unfold the bridge. Test 4 showed that air pressure could be used to open a folded bridge. Test 5 recorded the forces and movement necessary to unfold the bridge, showing that Shape Memory Polymer could be used in the bridge design. These tests showed that the folded tessellated bridge was an excellent candidate for 4D self–assembly.