Additive manufacturing enables the construction of near-arbitrary structures with the help of computational tool-path planning and print material properties. We explore an application of the technology to targeted repairs, such as mending holes or cracks, on 3D printed parts by using conformal tool-patting, combining the precision of additive manufacturing with the strength and homogeneity of material adhesion. Repair configurations vary in shape, size, material, infill and loading type are tested in 3-point bending for structural strength and strain. We provide and summarize the collected data in addition to a structural analysis and optimization of parameters relevant to reparative 3D printing.

**Research Question:**

How effective is repairing 3D printed structures with conformal 3D printing?

**Background:**

- 3D printing is typically used in quickly prototyping parts but has been used to repair damaged parts.
- Reparative 3D printing is known to repair damaged parts with the help of computational tool-path planning and print material properties.

**Methodology:**

- 3D printed parts are tested using the 3-point bending test, which provides data on the structural strength, failure method, and deformation under load.
- We investigated 3D printed objects and full information about a region of damage (such as a cavity), a conformal print fills and repairs the damage while meeting repair shape and infill constraints.

**Results:**

- An unexpected result is that the repaired parts perform better than their undamaged counterparts.
- Force sensor mounted on press measures applied load.
- Strain gauge attached to bottom of sample.
- Rounded D-shafts at supports.
- Load and stress/strain curve.

**Discussion:**

- An effectiveness rating better compares the load held by repaired vs. undamaged specimen. Percent effectiveness is defined as the load held normalized by the load held by the average undamaged specimen.

**Future Work:**

- T1 design testing while different infills pattern, allowing an analysis of which infill pattern may be more effective than others.
- Testing various damage types in order to improve repair methods in addition.
- Testing new materials such as ABS and Carbon Fiber PLA.
- Multivariate data analysis for optimization of printing, structural, and material parameters.
- Physical analysis supporting why repaired structures in compression perform better than their damaged counterpart.
- Study of parameters vital in obtaining information about damaged regions (as opposed to a solid print which would be compromised in this work).

In general, reparative printing has many applications. Provided that these printing methods have well-studied limitations, automated reparative printing is a promising material-efficient alternative to whole replacement and/or manual repair.