EngOpt2018 - 6th International Conference on Engineering Optimization
Instituto Superior Técnico, Lisbon Portugal • 17-19 September, 2018
Editors: H.C. Rodrigues, J. Herskovits, C.M. Mota Soares, et al.

Abstract ID 1054

DESIGNING COMPLIANT MECHANISMS FOR ADDITIVE MANUFACTURING. CONTROLLING THE MANUFACTURABILITY/FUNCTIONALITY RATIO THROUGH A FLEXIBLE OVERHANG CONSTRAINT.

Alain Garaigordobil, Rubén Ansola

University of the Basque Country, Spain
alain.garaigordobil@ehu.eus, ruben.ansola@ehu.eus

Keywords: Overhang Constraint,Topology Optimization,Additive Manufacturing,Compliant Mechanisms,3D printing.

Abstract: The concept “Topology Optimization for Additive Manufacturing” is a recently coined concept that refers to the complete engagement of topology optimization problems and additive manufacturing processes. The idea of coupling both technologies through a specific overhang constraint lies in the idea of a total design freedom, which classic manufacturing processes are unable to reach. If any design can be build, this will enable a continuum “design manufacturing” process eliminating prost-processing and any interference with the optimized geometry. In the field of structures there are already some ground-breaking approaches, there aren’t however any regarding the optimization of compliant mechanisms. The introduction of the overhang constraint within the topology optimization formulation of compliant mechanisms yields a compromise or inverse relation of functionality and manufacturability. The hinges of the flexible mechanisms are formed by a sharp thinning of the material members and describe a shape that possesses many tangents with different slopes, some of them showing not self supported contours. There is an inverse relation there for functionality and manufacturability. If the hinge is to be corrected so that a direct 3D printing of the mechanisms is possible, the global objective function will be harmed as the optimum-functional shape of the hinge is set aside. This paper introduces the advantages of a flexible overhang constraint for a more accurate topology optimization of 3D printed compliant mechanisms enabling intermediate design for different manufacturability/functionality ratios, and analyses the consequences of fully restricting scaffold structures respect to controlling and reducing them.