Optimization of an ankle foot orthosis for additive manufacturing using lattice structures

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Abstract.
Additive manufacturing technologies have been extensively used in the development of medical products, mainly due to its' complex geometry advantages. Orthoses are amongst the most common medical devices redesigned for additive manufacturing, as patient specific products. Ankle–foot orthoses are medical devices usually used as an aid for ambulation, providing both support and assistance, allowing the patient to move through the various stages of gait. Currently, most of these orthoses are thermoformed from plastic to allow for corrections for any type of ankle deformity. Advantages of custom and topologically optimized orthosis are mentioned by literature. The aim of this paper is to study the possibility of using lattice structures for the design and development of a functional ankle foot orthosis. The mechanical behaviour of an ankle foot orthosis was studies, starting with the premises of using 3 different materials: PLA, PET-G and Z-Hips. The ankle foot orthosis was optimized using lattice structures to reduce its weight but also to keep its original resistance. The resulted ankle foot orthosis model was loaded with 500 N, to simulate the real-life value of the force that is applied normally on an actual orthosis. Research results show that the optimum material was PET-G for both 50% and 100% lattice values.