Shape optimization of axisymmetric bodies subject to nonlinear loading

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This thesis has considered the alteration of designs into optimal shape which have desired levels of stiffness at different levels of deflection. This allows the user of this scheme to tailor their designs to carry whatever load their application requires, whilst simultaneously facilitating the possibility of reducing the total amount of material used. To achieve this a combination of mathematical optimization and some classical methods for modelling material mechanics are combined in what is called shape optimization.

The field of shape optimization is concerned with finding the best shape a structure can have for various purposes. An example of this could be the problem of finding the lightest possible airplane seat that is able to carry any passenger. With technological demands on products constantly increasing and with today's trends of sustainability shape optimization can help fill a slot by improving the design of products in whatever way is desired. These improvements are even further enabled by the fact that additive manufacturing methods are becoming increasingly sophisticated which enables to manufacturing of designs which are optimal in a mathematical sense, but that might not have been feasible before.

In this thesis the optimization of bodies with rotational symmetry such as rings or discs, which are subject to large deformations are considered. The optimization does not handle topological changes such as adding holes as an optimization step, and will require further development if that is to be implemented. Nevertheless, the developed optimization scheme still produces an improved design in several test cases compared to the response of the original designs. The produced work adds to already existing work in the field, which previously has generally been focused only on optimization for smaller deformations. In the end this is potentially not only valuable from an academic point of view, but the produced results could also have some practical benefits in that it could lead to implementations commercial software and it could help showcase the validity of shape optimization.