Public Abstract
First Name:Donald
Middle Name:
Last Name:Harby
Adviser's First Name:Yuyi
Adviser's Last Name:Lin
Co-Adviser's First Name:
Co-Adviser's Last Name:
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Over the years machine tools for manufacturing have developed into two classes. One is the general purpose machine tools, and the other is designed for machining large quantities of a specific part or process. These specialized machine tools are very effective, however they have disadvantages. One is that if the product design is changed, the machine tool may have to be redesigned and rebuilt. Another problem is the custom built machines usually have long lead-times for their design and build. A solution is to produce a reconfigurable or modular machine tool (MMT). Then custom machine tools could be designed and built quickly from a library of modular components. Using a library of standard steel components leads to a very interesting discrete structural optimization (DSO) problem.

A branch and bound discrete topology and sizing optimization method was applied to this problem. A hybrid approach of first using a particle swarm optimization (PSO) method and then switching to a fast gradient based method proved effective. A neural network (NN) based FEA approximation was developed to evaluate the constraints to the optimization. The results were compared to a more conventional material density topology optimization method. The method was successfully tested on a large scale 3D MMT component.