This thesis deals with topology optimisation for coupled convection problems. The aim is to extend and apply topology optimisation to steady-state conjugate heat transfer problems, where the heat conduction equation governs the heat transfer in a solid and is coupled to thermal transport in a surrounding uid, governed by a convection-diffusion equation, where the convective velocity field is found from solving the isothermal incompressible steady-state Navier-Stokes equations. Topology optimisation is also applied to steady-state natural convection problems.

The modelling is done using stabilised finite elements, the formulation and implementation of which was done partly during a special course as preparatory work for this thesis. The formulation is extended with a Brinkman friction term in order to facilitate the topology optimisation of fluid flow and convective cooling problems. The derived finite element formulation is implemented in an object-oriented parallel finite element framework programmed in the C++ programming language, developed by the Top-Opt research group of the Department of Mechanical Engineering at The Technical University of Denmark.

The presented work is seen as contributing new research to the field of topology optimisation for multiphysics problems. The topology optimisation of conjugate heat transfer problems is not very well documented in the literature, with only a few notable papers on the subject and to the authors knowledge, topology optimisation has not yet been applied to natural convection problems. Although the presented results are very simple and remain academic, it is envisioned that by further development, the methodology presented in this thesis, can be used to optimise realistic industrial problems such as the cooling of combustion engines or electronics. This thesis confines itself to steady-state laminar flow at low to moderate Reynolds, Péclet and Rayleigh numbers.