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# ISOGEOMETRIC SHAPE OPTIMIZATION FOR TIME DEPENDENT PROBLEMS

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The development of isogeometric analysis (IGA) has triggered renewed interest in shape optimization due to the seamless integration between computer aided design and analysis. Traditionally, shape optimization problems have been mostly limited to static loads. In the present contribution, the formulation of shape optimization is extended to include time-dependent loads and responses. A general objective functional is used to accommodate both structural shape optimization and passive control for mechanical and thermal problems. An adjoint sensitivity analysis is performed at the continuous level and subsequently discretized within the context of IGA. The transient problems, which lead to non self-adjoint formulations, are also solved using IGA. Several applications of time-dependent mechanical and thermo-mechanical problems are shown to illustrate the capabilities of this novel approach. In particular, the work presented is concerned with the following three topics: Firstly, shape optimization of a structure under quasi-static loading has been studied and validated using a passive control approach. The methodology is illustrated by considering a problem where an external load is allowed to move along the surface of a structure. The shape of the structure is modified in order to control the time-dependent displacement of the point where the load is applied. Secondly, shape optimization of a domain under transient heat conduction has been reformulated in a systematic and consistent way. This novel formulation has been validated using a passive control approach for transient thermal loading. Application problems, where the goal is to control the temperature or reduce the heat flux, have been analyzed. Finally, a third topic involves coupled problems with a quasi-static mechanical and a transient thermal load. In this case, the effect of the coupling between thermal and mechanical fields on the optimal shape is explored for cases in which the thermal strains play a significant role.