11th World Congress on Structural and Multidisciplinary Optimisation
07th -12th, June 2015, Sydney Australia

Simultaneous design of a loading location and structure by topology optimization

Sung Kyu Kwak[1], Byungseong Ahn[1], Suh In Kim[1] and Yoon Young Kim[1]

[1] Seoul National University, Korea

Abstract

One can find an optimal topological layout for a given load applied at a specified location. Here, our concern is to simultaneously determine the loading location as well as a structural layout by the topology optimization setup. Earlier, this kind of problems were dealt with by some investigators, but the loading location was designated along a line of a path such as a vertical line. Here, we do not limit the loading location to be only along a line, but we allow it to be located anywhere inside a design domain or along a domain boundary. Because of this relaxation, the simultaneous design of a loading location and a structural layout becomes more difficult to solve.

In this work, we propose a new method to solve the simultaneous design problem in which the loading point can be located anywhere. The direction of an applied load is assumed to be unchanged. To pursue this goal, we newly introduce a so-called loading design domain discretized in one-dimensional spring elements only. This domain physically occupies the same domain as the design domain for a structural layout, but it facilitates putting the loading point anywhere while keeping the loading direction without generating undesired additional force resultant. The structural design domain is discretized by usual finite elements the densities of which are interpolated by design variables. Likewise, the spring elements connecting a load located at an arbitrary point and the nodes of loading design domain are interpolated by another set of design variables. One issue in the proposed two-design domain modeling is how to choose the objective function and constraint functions to make a meaningful design problem and produce a highly-performing structural layout. Some numerical examples, including a simplified problem to design a real wheel-loader frame and a loading location are presented.