Universität Stuttgart

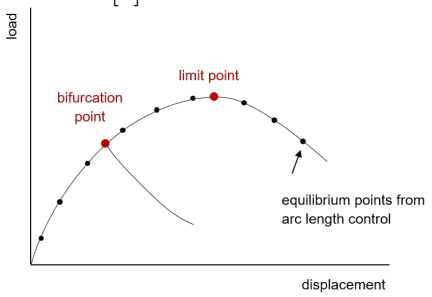
Baustatik und Baudynamik

Master Thesis

Implementation and comparison of different methods for the exact calculation of critical points

Critical points are of utmost engineering significance due to the special physical characteristics of structural behavior in their vicinity. Limit points initiate snap-through of a structure and at bifurcation points the structure begins to buckle. With standard path-following methods, these critical points can be estimated but not calculated exactly, since only individual points of the equilibrium path are determined, which are not necessarily critical points.

There are several methods that can be used to calculate critical points, such as limit and bifurcation points, exactly. Within this thesis, three of these methods should be implemented and compared with respect to efficiency and performance. These are the method of extended sytems [1], the minimally augmented method [2] and bisection methods [3].



Equilibrium path with critical points.

The specific tasks are

- Literature research on methods for the exact calculation of critical points
- Implementation of the three methods in Matlab/Ikarus
- Comparison of the methods in terms of efficiency and performance using various examples of limit and bifurcation points

Recommended fields of interest

Nonlinear Finite Elements, stability analysis, programming in Matlab/C++

Literature

[1] P. Wriggers, W. Wagner, C. Miehe, *A quadratically convergent procedure for the calculation of stability points in finite element analysis*, Comput. Methods Appl. Mech. Engrg. 70 (1988) 329–347.

[2] J.-M. Battini, C. Pacoste, A. Eriksson, *Improved minimal augmentation procedure for the direct computation of critical points*, Comput. Methods Appl. Mech. Engrg. 192 (2003) 2169–2185.

[3] J. Shi, *Computing critical points and secondary paths in nonlinear structural stability analysis by the finite element method*, Comput. Struct. 58 (1) (1996) 203–220.