Computational aspects of the velocity based elements in post-buckling analysis of beams and frames.

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In the nonlinear stability analysis of structures undergoing complex deformation, the precise prediction of the behaviour of the structure in the post-buckling regime poses a serious challenge during the finite element analysis. The problem is multifold in nature and requires numerous calculation such as, precise identification and classification of critical points, identification of correct loading path etc. Near the critical points of the equilibrium path, the load-deflection characteristics are dynamic in nature and requires short time intervals to simulate quasi-static load increment. In addition, time dependent load-relaxation techniques are necessary for the structures exhibiting snap-through and snap-back behaviour. In the present work, we use the velocity based finite element formulation of a geometrically exact beam model with the extension of the equilibrium equation with a modified arc length constraint. The crucial idea of the formulation is to employ velocities in the fixed frame description and angular velocities in the moving frame description as the primary unknowns. The model allows the use of standard additive type interpolation functions to be fully consistent with the configuration space. We present some preliminary results of the post-buckling analysis with suitable numerical examples. The present work serves as a starting point in the post-critical analysis of structures such as beams and frames.