# Damage detection in Timoshenko beams using neural networks and non-linear vibration data

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Detecting beam cracks in their early growth stage is important for economical and life-safety reasons. This work presents a method which uses vibration data to detect cracks in Timoshenko beams experiencing geometrically non-linear, forced vibrations. This method is based on a combination of Hopfield neural networks [1]. Each network produces a time-evolving estimate of the beam parameters at a certain beam point. The combination of the networks enables them to share information concerning different beam points. Damage is detected when the method tracks a change in the beam parameters. The input to the method consists of the beam vibration data. These data are simulated using a p-finite element, with appropriate displacement shape functions, of a beam model based on Timoshenko's theory for bending, complemented by an approach similar to von Kármán's, but for beams, to account for the geometrical non-linearity [2]. The crack is represented by a small indentation on the beam, with consequent changes on mass and stiffness. The equations of motion are obtained by the principle of virtual work and numerically solved by Newmark's method [3].

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