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Sunsets from Heavy Cantilever Oscillations.

A cantilever beam, or a beam that is fixed against translation and bending at one end while remaining free at the other end, is called 'heavy' in structural analysis if the weight of the beam itself is included in the analysis. Here, large amplitude vibration of a vertical, heavy cantilever was investigated. The natural frequencies of a cantilever actually change at large amplitudes, and only nonlinear partial differential equations can be used, without linear approximations, to study this behavior. Here, governing arclength equations were derived to model dynamic and static behavior and then numerically solved using a finite-difference method to solve the boundary value problem. A spectrogram was generated to illustrate the relationship between amplitude of motion and vibration frequencies, and this was done by including damping in the system model. After generating a time series of motion with a large initial deflection of the cantilever, a short-time fast Fourier transformed was performed to determine the powers over a frequency range as the amplitude of motion decayed. What resulted was a series of images showing feather-like structures, or, with a particular coloring scheme, a stack of sunsets that change for a range of amplitudes. (Received September 23, 2018)