# High codimension bifurcation in suspended cables under aerodynamic forces

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**Abstract**

Suspended cables are commonly used structures in many civil and industrial applications. In cold regions, where ice accretions can break the axial-symmetry of the cable cross-section, the occurrence of the galloping phenomenon is often observed, and cables experience high amplitude/low frequency oscillations, even for moderate and uniform wind (1). The phenomenon can be explained as a Hopf bifurcation happening at a certain critical wind velocity, and limit cycles occurring in post-critical conditions. In (2), a mechanical model of cable was proposed, where the wind was assumed to: (a) modify the equilibrium configuration initially occupied by the cable under self-weight, through the mean component; (b) induce the Hopf bifurcation from the modified equilibrium through the dynamic component. There it was observed that, besides the wind velocity which represents the main bifurcation parameter, a second parameter, namely the initial orientation of the ice accretion, was crucial to determine whether the critical mode was of symmetrical or anti-symmetrical shape. Furthermore, a third parameter, namely the initial sag-to-span ratio, was able to change the critical frequency of the symmetric mode.
It mean that there exist a critical value of the three parameters (wind mean velocity, initial orientation of the ice accretion and sag-to-span ratio) at which a 1:1 resonant double Hopf bifurcation occurs, i.e. where the symmetric and anti-symmetric modes have both the same critical wind velocity and frequency.

Here, the critical conditions for the occurrence of the mentioned codimension-three bifurcation are sought and the post-critical analysis is carried out, paying special attention to the transitions from non-resonant to resonant double Hopf bifurcation.

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*References*

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