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On the stability of one-sided periodic oscillations in MEMS via lower and upper solutions method.

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In aim of this talk is provide an analytical study on the existence and linear stability of positive periodic solutions for the Nathanson's model and the Comb-drive model, two special type of Micro-Electro-Mechanical-Systems (MEMS). These results contribute to a better understanding of these models and therefore, they add up to the set of tools to decide the range of usefulness in sensing and acting of these two models. Both models are considered without damping and having an AC-DC input voltage $V = V(t) > 0$ of period $T > 0$. For the Nathanson's model, we show the existence of two T-periodic solutions $0 < \psi(t) < \phi(t)$, under the assumption that the voltage is less than the pull-in voltage and greater than a certain positive constant depending on the temporal frequency of V and physical parameters. The solution is elliptic and, if the parameter $\lambda = \dfrac{\min_t V(t)}{\max_t V(t)}$ is greater than a certain critical value, the solution ϕ is hyperbolic. Under the same conditions that guarantee the existence, we prove the uniqueness of these two solutions and we classify their linear stability. The Combdrive model is studied under a cubic stiffness with coefficient $\alpha > 0$ and its dynamic depends on whether $\alpha > 2$ or $\alpha < 2$. In any case, we will show the existence of a $T-$periodic positive solution. When $\alpha < 2$, this periodic solution is unstable for λ greater than a certain critical value and V below the pull in voltage. For the case $\alpha > 2$, similar to the Nathanson case, we prove the existence of two positive periodic solutions one of which is linearized stable and the other is unstable. The methodology uses the Lower and Upper Solution Method. Some numerical examples are provided to illustrate the results.

Keywords: Nathanson's model, Comb-drive model, periodic solutions, lower and upper solution method.

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