Monostable, bistable, and tristable scenarios in a simple mechanical model with LuGre friction

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The frictional interaction between contacting bodies is based on very complex physical processes. To model their combined effect, researchers in the related fields have introduced numerous empirical models that are adapted to the needs of various application areas [1]. The present paper focuses on the widely used LuGre model. We consider a remarkably simple mechanical model: a block on a horizontal surface subjected to an external force F, the LuGre friction force F_f (including bristle damping) and a viscous damping force Cv (see Figure 1(a)).

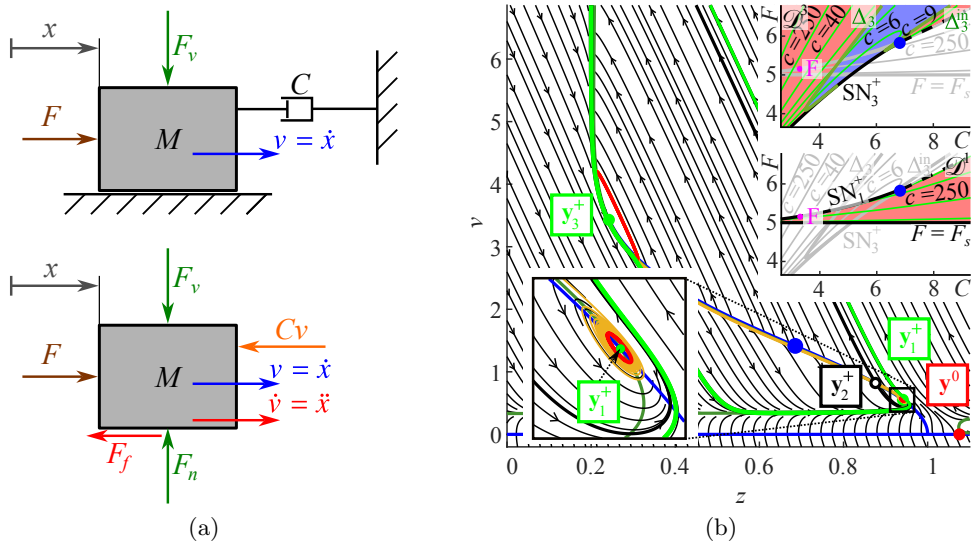

Figure 1: (a) Mechanical model and (b) a tristable scenario with two stable slipping equilibria ($\mathbf{y}_1^+$, $\mathbf{y}_3^+$) and a stable limit cycle. Stable/unstable solutions are drawn in green/red; v and z denote the velocity of the block and the internal variable of the LuGre model, respectively.

Following the analysis initiated in [2, 3], we point out several local and global bifurcations in the system that lead to the appearance of coexisting stable solutions in the phase-space, as shown in Figure 1(b). The implications of these results are discussed in our presentation in connection with the passivity property of the friction model.

References

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