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Title: The role of canards in transition to bursting and spike adding

Abstract :

Bursting is one of the essential behaviors observed in cellular activity, in relation to either electrical or secretion events. The main characteristic of a bursting signal is the alternation between slow (silent) phases with no oscillations or small-amplitude (sub threshold) oscillations, and fast (active) phases with large-amplitude oscillations (groups of spikes). Since the pioneering work of Rinzel, bursting has been extensively analyzed in ODE models that possess multiple timescales. The underlying slow-fast structure of these models allows to understand the overall features of the bursting solution as a succession of slow passages near families of attractors of the fast subsystem interspersed with periods of slow evolution. Rinzel proposed a classification of bursting patterns into three main classes: square-wave, elliptic and parabolic. We revisit these three bursting classes and explain how, in every case, the transition from oscillatory dynamics to bursting is organized by so-called canard solutions, which also turn out to play an essential role in controlling the number of spikes per burst upon variation of a control parameter. We distinguish three different canard based bursting mechanisms: transition to square wave bursting through a generalized canard explosion, transition from fast oscillation to elliptic bursting through torus canards and transition from slow oscillation to parabolic bursting through a homoclinic-like bifurcation involving a folded saddle and the associated canard. This is joint work with Mathieu Desroches and Tasso Kaper.