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Complex neuronal bursting oscillations : the role of slow variables

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In this talk, I will present recent work on multiple-timescale dynamical systems displaying complex oscillations with both slow and fast components, with application to modeling neuronal activity. After a brief review of bursting oscillations and their multiple-timescale analysis, I will revisit the classical parabolic bursting scenario and show how to understand its spike-adding structure by studying the dynamics of slow variables of such models in their singular limit, and the presence of a so-called folded-saddle singularity. Then, I will look at bursting models with a folded-node singularity, show a biophysical example as well as constructed examples that extend the classical Rinzel-Izhikevich bursting classification scheme. Throughout these two cases (folded saddle and folded node) I will show examples of such bursting dynamics with two slow variables at both single-cell and population levels. In particular, I will show how the burst-excitable structure of networks of theta model may persist across scales up to some mean-field limit.
[This is based on joint papers with D Avitabile (VU Amsterdam), GB Ermentrout (U of Pittsburgh), J Rinzel (NYU & CIMS) and S Rodrigues (BCAM, Bilbao)]

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