Modeling the origin of coherent activity in gravid uterus

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The project proposes developing and analyzing a biologically realistic model of activity in the pregnant uterus. An important scientific question concerns the origin of spontaneous electrical excitation that is responsible for generating contractions in the organ close to term. As no specialized pacemaker cell has been identified so far, we have proposed an explanation of the rhythmic activity, based on the fact that increased coupling between excitable and passive cells results in spontaneous oscillations, none of which being active in isolation. In this project, we shall investigate the transition to spontaneous oscillations in a system that incorporates biological complexity at several levels: (a) cellular, in particular using a realistic descriptions of ionic currents, and Calcium dynamics in muscle cells, (b) tissue, stressing the heterogeneity in the spatial distribution of passive cell density, and (c) entire organ, focusing on the role of threedimensional geometry in producing the intra-uterine pressure necessary to expel the foetus during delivery.
The objectives of the project are:
Understanding the transition towards strong electro-mechanical contractions in the uterus using realistic models.
At the organ level, constructing a 3-dimensional model of the uterus.
At the tissue level, including the heterogeneities in cell composition.
At the cellular level, incorporating a detailed description of the ionic currents involved.

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