**Continuity equations and super-resolution microscopy   
for the reconstruction of a cell membrane potential.**   
  
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Continuity equations are fundamental building blocks in the   
modelling of natural systems at the mesoscopic and macroscopic level.   
Therefore they are also essential in engineering control mechanisms   
and in the formulation of inverse problems. In this framework, a central role is   
played by the Liouville, the Fokker-Planck-Kolmogorov (FPK) and the   
Boltzmann equations.    
  
In this talk, the focus is on the stochastic motion of molecules on a cell membrane   
and its modelling by a nonlinear mean-field FPK equation with the   
purpose to illustrate a new method for the reconstruction of cell membrane   
potentials based on super-resolution microscope images.   
  
This inverse problem is formulated as an optimization problem governed by   
the mean-field FPK equation, and the functional to be minimized includes   
a least-squares error term of the computed and observed particles'   
densities and a Tikhonov regularization term. This problem is solved on a   
sequence of time windows to determine the potential together with an estimate   
of uncertainty of its reconstruction.   
  
Results of numerical experiments are presented that successfully validate the proposed   
reconstruction procedure and demonstrate its applicability   
in a super-resolution microscopy framework.   
This is joint work with Mario Annunziato (U Salerno)