Combined parameter and state estimation method for carbon nanotube-based nanosensor arrays distributed on 2D field

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In this presentation, a combined parameter and state estimation method for converting discrete light emission signals from CNT-based sensor arrays distributed on 2D spatial field into quantitative concentration distribution of target molecules. Signals of a single sensor, on which monomolecular adsorption and desorption events of the molecules are detected in nano-scale, show inherently stochastic characteristics. The maximum likelihood estimation method based on the chemical master equation is used for estimating the adsorption parameter, which is a function of the local concentration of surrounding target molecules. The local concentrations for sensor arrays are determined by macroscopic phenomena of the whole 2-D system such as the diffusion. PDEs describing the diffusion phenomena are used within the moving horizon estimation framework to improve the estimation of the entire concentration distribution on the 2D field. The fast moving horizon estimation algorithm employing decoupling of a large-scale system and an approximated penalty method is implemented. From this method, we can efficiently obtain physically meaningful data from stochastic signals.