

# Sliding Mode Control of fractional order systems: application to sensors

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Sliding mode controls (SMCs) are applied during sensor operation in order to accelerate their time response and/or obtain other improvements in performance. The main objective is to avoid the typically slow dynamics of the underlying physical structures (thermal circuits, diffusion processes, etc.). This can be achieved by designing controls that continuously compensate the effects of the external factors to be measured, so that the state variables of the system remain constant. The necessary control actions are then the new system output, which can be significantly faster than in open loop operation. Additionally, it is also possible to improve in other ways such as increasing sensitivity, or avoiding effects of some parasitic elements or even mitigating the effects of undesired external influences.

In many applications, the dynamics of the physical structures can be modelled using fractional calculus (thermal sensors, charge trapping in dielectrics, chemical sensors, etc.). In this paper we present how Diffusive Representation can be used to model fractional order systems, and how the dynamics of the system, working under SMCs, can be analysed in the infinite sampling approximation. We will present how external disturbances trigger changes in the control actions, which must be adapted to compensate their effect.

Experimental examples will be presented for two different applications: compensation of charge trapping generated by ionizing radiation in MOS capacitors, and control applied to heat flux sensors.

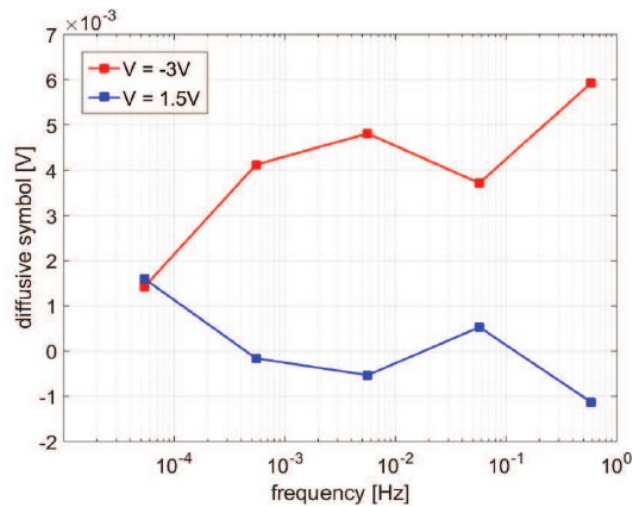


Figure 1: Diffusive symbol of charge trapping dynamics in a MOS capacitor for two bias voltages.

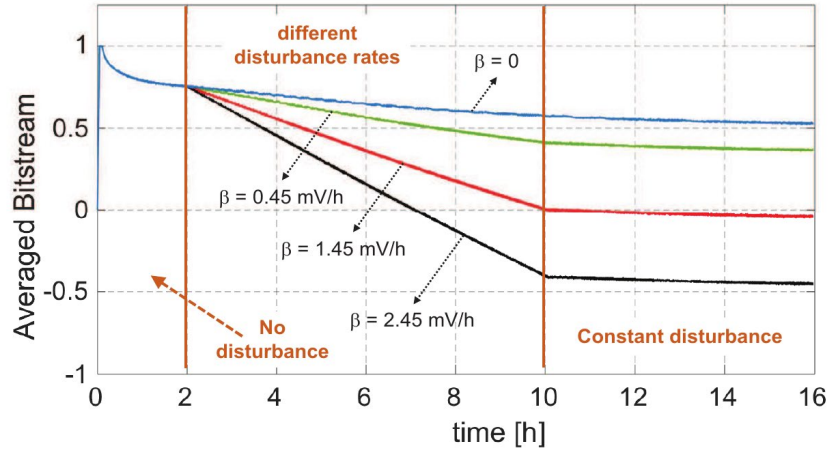


Figure 2: Analysis of how X-ray radiation, for different dose-rate values ( $\beta$ ), alters the control actions of a charge trapping control of a MOS capacitor.

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