**Modelling cerebellar tremor as a feedback instability**

The cerebellum is a part of the brain involved in motor control. Patients with lesions of the cerebellum suffer from both a tremor during movements, and an inability to execute rapidly alternating movements. Recently a very debilitating disorder, called 'essential tremor', has been associated with micro-lesions in the cerebellum. The uncontrollable 4-10 Hz tremor manifests itself particularly during loading of the arm (for instance grasping a glass of water), to the point that patients may require assistance for feeding themselves. Deep brain stimulation through implanted electrodes can help in some patients, but the mechanism underlying the success of this treatment is unknown.

Current models of the involvement of the cerebellum in motor control are inspired by engineering but remain rather conceptual ('adaptive control', 'forward control', etc.) without taking into account the anatomy or synaptic organization of the actual brain circuits.

The goal of this project is to build simplified computer models of an effector limb (the arm) and of the circuits intervening in the two-way transmission between the cerebellum and the effector: motor signals from the cerebellum to the limb muscles on the one hand, and sensory feedback to the brain on the other hand. Several stages within this circuit are organised in a feedback fashion, and could, when inappropriately tuned or delayed, cause unwanted oscillations: feedback control of muscle length by the spinal cord, antagonism between muscle pairs, pattern generators in the brainstem, visual feedback etc.

The model, to be built by adding gradually higher levels of motor control (corresponding to hierarchically higher structures in the nervous system), will consist of a set of ordinary differential equations that can be studied analytically and numerically. The aim is to localize the feedback component most likely to lead to instability. There are applications to human motor control, rehabilitation, and robotics.

Experience with the theory of linear and nonlinear systems, control theory, and stability analysis are essential. No particular knowledge of neuroscience is required.

This work will be conducted in the Bio-computation Research Group of the Department of Physics, Engineering and Computer Science at the University of Hertfordshire (College Lane campus).

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