

Allegro non troppo: moderated optimal control

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Abstract:

When modeling a conscious agent, the constant cost function of a traditional time minimization problem can be interpreted as representing a uniform stress or risk throughout the task, while more general cost functions model varying stresses and risks that depend on the current state and control values. An inadequate response can have immediate fatal consequences, but over-reacting to every stressor generates unsustainable wear-and-tear. A moderation incentive is a control-dependent cost term that is identically zero on the boundary of the admissible control region, and is subtracted from the 'do or die' cost function to reward sub-maximal control utilization in optimal control systems. A moderation potential is a function on the cotangent bundle of the state space such that any solution of the associated Hamiltonian system satisfying the given boundary conditions is a solution of the synthesis problem (the control-parametrized Hamiltonian system central to Pontryagin's Maximum Principle). An elementary planar projectile problem and incorporation of simple models of pain and fear into the classic falling cat problem illustrate the approach.