**Optimization of complex movements: a challenge for biorobotics**

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Being so common in animal kingdom and our daily activities, movement is not usually associated to the concept of computational complexity and intelligence. In reality even an apparently simple motor performance involves a complex coordination of neuromuscular activities required to reach a multiparametric optimization including: precision, equilibrium, speed, environment interaction, energy minimization etc. To achieve such goal our brain processes information about the internal state of the body (proprioceptive feedback) and the external world (visual, tactile, vestibular, auditory feedback). Computational modelling combined with quantitative analysis of movement; brain functional imaging and genomics could answer new questions on the role of learning vs genetic predisposition in skilled motor performances. For this purpose we have investigated selected motor tasks involving a multijoint coordination, which belongs to the repertoire of ordinary movements, in order to compare different motor strategies adopted by a population of naïve subjects with a population of high level performers who have undergone specific and intensive training in equilibrium and movement control (from dancers to sport performers and astronauts). Results demonstrate that long-term training makes it possible to build up a new motor program where feedforward control is dominant and synchronous activations of sets of agonistic muscles are replaced by proper temporal sequences leading to a more efficient performance in term of equilibrium control and speed. Implications of these findings will be discussed for biorobotics and designing a new generation of prosthesis and systems able to interact and actively adapt to the patient needs to improve recovery of motor functions and quality of life.