
Energetics, Efficiency and Performance of FES-Cycling

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Résumé

This talk will discuss the energetics, efficiency and performance of FES-cycling. I will present a formal methodology for estimation of the metabolic efficiency of cycling, which is specifically tailored to the low-power regime typical of FES-cycling: efficiency estimation is based upon measurement of oxygen uptake during steady-state exercise, and takes into consideration the negative, internal power required just to move the mass of the legs. An important backdrop for this talk is the FES bike race which took place at the Cybathlon competition in Zürich in October 2016, where my team achieved the fastest time of any team which used surface stimulation (the race was won by team Cleveland which, uniquely, employed implanted stimulation technology). By analysing the times achieved by the bike race teams, which used a variety of technological approaches, important lessons can be learned regarding optimisation of FES-cycling performance.

I will also describe a range of research studies from my lab where we have investigated multi-electrode configurations (including spatially-distributed sequential stimulation, SDSS) and different ways of stochastically (randomly) modulating stimulation parameters (inter-pulse interval [and thus frequency], and pulse amplitude and width).

Based on the above elements, the talk will conclude with a set of recommendations aimed at improving FES-cycling performance. The key elements of these recommendations are: employment of multi-electrode configurations, random modulation of stimulation parameters, targeting of motor points; and elements of bike tuning, including customisation of the ankle orthoses, employment of non-circular cranks and automatic gear shifting.

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