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Cocontraction of pairs of antagonistic muscles: Analytical solution for planar static nonlinear optimization approaches. (English) Zbl 0784.92003

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Summary: It has been stated in the literature that static, nonlinear optimization approaches cannot predict coactivation of pairs of antagonistic muscles; however, numerical solutions of such approaches have predicted coactivation of pairs of one-joint and multijoint antagonists. Analytical support for either finding is not available in the literature for systems containing more than one degree of freedom.

The purpose of this study was to investigate analytically the possibility of cocontraction of pairs of antagonistic muscles using a static nonlinear optimization approach for a multidegree-of-freedom two-dimensional system. Analytical solutions were found using the Karush- Kuhn-Tucker conditions, which were necessary and sufficient for optimality in this problem. The results show that cocontraction of pairs of one-joint antagonistic muscles is not possible, whereas cocontraction of pairs of multijoint antagonists is. These findings suggest that cocontraction of pairs of antagonistic muscles may be an "efficient" way to accomplish many movement tasks.

MSC:

[92C10](#) Biomechanics

[49N70](#) Differential games and control

[49N75](#) Pursuit and evasion games

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static, nonlinear optimization approaches; cocontraction of pairs of antagonistic muscles; multidegree-of-freedom two-dimensional system; analytical solutions; Karush-Kuhn-Tucker conditions; movement tasks

Full Text: [DOI](#)

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