Wu, J. Z.; **Herzog, W.**; **Cole, G. K.**

Modeling dynamic contraction of muscle using the cross-bridge theory. (English)

Zbl 0880.92005
Math. Biosci. 139, No. 1, 69-78 (1997).

Summary: During normal, voluntary movements, skeletal muscles typically contract in a highly dynamic manner; the length of the muscle and the speed of contraction change continuously. We present an approach to predict the accurate behavior of muscles for such dynamic contractions using Huxley's cross-bridge model. A numerical procedure is proposed to solve, without any assumptions, the partial differential equation that governs the attachment distribution function in Huxley's cross-bridge model. The predicted attachment distribution functions, and the corresponding force responses for shortening and stretching, were compared with those obtained using *G.I. Zahalak*'s [ibid. 55, 89-114 (1981; Zbl 0475.92010)] analytical solution and those obtained using the so-called "distribution moment model" in transient and steady-state contractions.

Compared to the distribution moment model, the solutions obtained using our model are exact rather than approximate. The solutions obtained using the analytical approach and the present approach were virtually identical; however, in terms of CPU times, the present approach was 250-300 times faster than Zahalak's. From the results of this study, we concluded that proposed solution is an exact and efficient way for solving the partial differential equation governing the cross-bridge model.

MSC:

92C10 Biomechanics
92C30 Physiology (general)
65Z05 Applications to the sciences
35Q92 PDEs in connection with biology, chemistry and other natural sciences

Keywords:

actin-myosin bonding reaction

Software:

IMSL Numerical Libraries

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