OPTIMIZATION OF THE MUSCULOSKELETAL SIMULATION IN ESTIMATION OF METABOLIC COST

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Energy from food is supplied to the human body in the form of chemical energy in the muscles. This metabolic energy expenditure is one of the main determinants of the way we walk, and indirect calorimetry measurements are an essential tool for understanding how increases in metabolic cost restrict the mobility of clinical populations. Respiratory oxygen consumption measurements allow recording of the average metabolic cost of walking. However, the time required for these measurements prevents assessing metabolic rate in patients who cannot walk long enough. Musculoskeletal modeling techniques allow to estimate average muscle energy expenditure during locomotion in conjunction with muscle metabolic rate equations. One of the most widely used equations for estimating human metabolic cost (i.e., Umberger) is based on a mix of literature sources, including ex-vivo and animal experiments. However, a wide variety of parameter derivations can affect the agreement between model predictions and experimental results. Although a reasonable agreement was found between model predictions and experimental results, enhancing the level of agreement is possible by improving the coefficients and options that come from non-human experiments. In this project, we aim to optimize the coefficients and options in the Umberger model to improve its overall accuracy and agreement with experimental results compared to previous literature. The cost function of the optimization will be to minimize the error in the estimated stride average metabolic cost from the stride average indirect calorimetry.