

# Mathematical Modeling of Emotional Body Language during Human Walking

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**Abstract:** Mathematical modeling and numerical simulation and optimization - i.e. classical tools of scientific computing have proven to be very helpful to gain a better understanding of the complex control mechanisms during human movements. In the project presented in this talk we use these tools to study the implicit bodily expression of emotions during everyday human movements such as walking forwards. The study of emotional facial expressions and of emotional body language is currently receiving a lot of attention in the cognitive sciences. An underlying assumption of our work is that all human motion is optimal in some sense and that different emotions, such as fear, happiness, sadness, anger etc., induce different objective functions, which result in different deformations of normal motion. The goal of this project is to identify the objective functions (or in general combinations of several objective functions) that underly each emotion. From a mathematical perspective, this requires the solution of an inverse optimal control problem. We created a 3-D rigid-body model of a human of which we use the dynamics simulation in an optimal control context. We performed two kinds of optimization: i) reconstruction of dynamic quantities of pre-recorded data of emotional walking motions by least squares criteria and ii) forward optimization that generates neutral and varied walking motions using different objective functions. These two serve as preparation to identify suitable base function candidates that will be used in the inverse optimal control context.

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