

## Optimal Technique, Variability, Control, and Skilled Performance

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Computer simulation modelling is a powerful tool in Sports Biomechanics that allows the researcher to investigate the underlying mechanics of technique. Optimisation is often used in conjunction with simulation modelling in an attempt to explain the technique adopted in skilled sport performance. This might take the form of minimising joint torques in an expectation that the optimum technique will resemble the actual performance. Many tasks in everyday life may be based on minimising such variables, however, in the field of sport effort is often maximised in order to achieve the performance outcome. Therefore, while optimal technique should lie within the constraints of realistic strength characteristics there must be other criteria that explain the athlete's technique. Where more than one technique exists for performing the same skill, for example, identifying suitable optimisation criteria may give some insight into the adopted techniques. However, optimal technique, by definition, can be sensitive to perturbations. For example, small errors in timing an optimal technique may lead to a sub-optimal or even failed performance. Since in all human movement there is inherent variation so that

no two performances are exactly the same, skilled technique needs to be successful in a noisy environment and so optimised technique also needs to be robust to the inherent variation in coordination. This requires the measurement of human movement variability so that it can be incorporated into the optimisation procedure. In movements in which there is sufficient time for feedback control to operate it is to be expected that there will be greater variation in technique in those phases that adjustments are made. It is also to be expected that there will be little variation in technique for those phases where accurate coordination is crucial to the success of the movement. The aspect that often governs elite technique is that of achieving consistent success rather than some biomechanical measure of movement. The presentation will demonstrate, through a number of case studies, how computer simulation modelling and optimisation may be used to gain an insight into the important aspects of gymnastics techniques and the importance of including aspects of motor control when investigating limiting movements.

### KEY WORDS:

simulation, optimisation, motor control, variability