Introduction

Twist may be produced during a forward somersault by extending asymmetrically from a piked position. For a twist to the left the body is flexed over the right hip prior to becoming straight. This asymmetrical hip movement produces a tilt of the longitudinal axis away from the vertical somersault plane and twist results in order to maintain constant angular momentum during flight. The amount of tilt, and hence the resulting twist rate, is sensitive to the amount of side flexion used. Since there will be some variation in the amount of side flexion used in each performance, it will be necessary to make in-flight corrections in order to complete the required amount of twist. This study investigates a method of making such corrections using a computer simulation model of aerial movement.

Methods

An 11-segment computer simulation model of aerial movement was used to produce a forward somersault with 1.5 twists. Asymmetrical hip movement during the aerial phase was used to initiate the twist and to stop the twist. During the (twisting) mid-phase of the movement the body was straight with arms abducted 90°. This simulation was used as a target performance in a perturbation study. Another simulation was carried out in which there was 20° less hip flexion when in the side-flexed position. This resulted in less tilt and a lower twist rate so that the final amount of twist produced was less than 1.5 rev. A trampolinist is able to sense this lower twist rate by means of the balance mechanisms in the inner ear which detect the centripetal acceleration. A control system with feedback time delay was introduced into the simulation model by reducing the arm abduction angle during the twisting phase as a linear function of the difference between the twist rate in the simulation and the corresponding twist rate in the target simulation.

Results

The simulation with 20° less side hip flexion resulted in 1.38 twists rather than the 1.50 twists of the target simulation. When the arm abduction angle during the twisting phase was decreased in proportion to the difference between the twist rate and the target twist rate, the amount of twist in this phase increased from 0.92 rev to 0.99 rev, almost equalling the 1.00 rev in the corresponding phase of the target simulation. The total twist at the end of the simulation was only 1.44 rev, however, due to less twist occurring in the initial and final phases when the hips were flexed. This was compensated for by increasing the amount of arm adduction produced by the control model so that the final twist was 1.50 rev. When a time delay was introduced into the control system this resulted in insufficient twist being produced. Again this was catered for by increasing the amount of arm adduction. Time delays of up to 300 ms could be accommodated.

Discussion

The limiting factor in being able to successfully compensate for a slow twist rate and a long time delay was the amount of arm adduction that was possible.