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ON THE INVESTIGATION OF FLIGHT PREPARATIONS IN SPORTS

[1] **Svein Linge,** [2] **Oddvar Hallingstad and** [1] **Tron Krosshaug**

[1] The Norwegian University of Sports and Physical Education, Oslo, Norway
[2] Center for Technology at Kjeller, Kjeller, Norway

Introduction and Methodology

In sports like gymnastics, springboard diving, freestyle, etc., free flights through the air constitute an important part of the activity. How to prepare for such flights in order to get them right is then an important matter. When the body initiates the flight, it will stay in the air for a certain time with the given angular momentum achieved up till take off. During the flight *preparations* the athlete may increase the mechanical energy, as well as "distribute" it between flight time and rotation. The optimal distribution depends on the actions planned during flight.
We illustrate how such flight preparations may be investigated through definitions of appropriate *Flight Profiles*, and further how these profiles alleviate the analysis of different simulated flight preparations based on robotic models from ROBMAT (ROBotics with MAThematica, Horn and Linge (1994)).

Results

We adopted the normalization idea of Yeadon (1990), who compared the count of *hypothesized* straight body somersaults between gymnasts as computed from their angular momentum and flight time. However, by regarding "every" point *during* flight preparation (i.e. *prior* to flight) as a hypothetical flight initiating point, we achieve a set of such numbers. This reveals how the number of straight body somersaults *develops* during preparations. Further, since the number of straight body somersaults is the product of a corresponding angular velocity and flight time, the developments of these two components may be studied side by side, giving a more detailed picture of the preparations. On these grounds, we arrive at the Flight Rotation Profile (F_{rp}) and the Flight Time Profile (F_{tp}), which through appropriate multiplication combine into the Flight Potential Profile (F_{pp}).
A flight preparation example from gymnastics is modelled via ROBMAT in 2D and simulated to see how different body actions correspond to different developments of the Flight Profiles.

Conclusion

The defined Flight Profiles were found convenient for a more detailed assessment of body action strategies during flight preparations.

References

Horn, G. and Linge, S. (1994) Analytical generation of the dynamical equations for mechanical manipulators, *The Mathematica Journal*, **4**, 67 - 73.

Yeadon, M.R. (1990) The simulation of aerial movement - III. The determination of the angular momentum of the human body, *Journal of Biomechanics*, **23**, 75 - 83.