Abstract Aminian

Kinematics of ski jumper using 3D inertial sensors for take-off optimization and performance evaluation

Main investigator: Prof. Kamiar AMINIAN

Contact: EFL-STI-LMAM, ELH 132, Station 11, 1015, Lausanne
(kamiar.aminian@epfl.ch)

Ski jumping involves a complex sequence of movements including the in-run posture, the take-off extension, the early-flight, the stable flight and the landing. Even if take-off and early-flight are considered as the most important phases since they establish the initial conditions for flight, the whole sequence has to be considered to judge the quality of a performance. Therefore designing adequate monitoring system able to record and extract relevant kinematic, dynamic and coordination-symmetry parameters during hill jumps as well as providing immediate objective feedback to the trainers is then of primary importance.

In this project, a new method monitoring system has been designed to evaluate the performance of hill jumps. Based on wearable miniature 3D inertial modules the system provides qualitative and quantitative information and metrics to trainers and athletes on *what* was wrong, when it was wrong and *why* it was wrong. More specifically, the outcomes of the project are:

- An easy to wear measurement device integrated in the athlete's apparel to record the complex movement of the jump in real conditions.
- 3D reconstruction of kinematics and dynamics during the whole jumping sequence (from in-run to landing) as well as the computation of the take-off inter-joint and inter-segment coordination and symmetry.
- New performance related metrics based on the reconstructed kinematic, dynamic and coordination curves.
- Statistical validation of the relevance of the new metrics thanks to the measurement of 35 athletes realizing up to three jumps in training conditions.
- An easy-to-use software interface by reporting relevant metrics and providing direct feedback to coaches and athletes.

By considering various kinematic and dynamic aspects, the segment and joint coordination and the optimization of different phases during hill jumps, this project has opened an important topic for objective evaluation of the performances of the athlete and his field training. It provided not only objective outcomes such as which kinematics parameters were the most correlated to the final jump length but also a system able to give immediate feedback to the trainers. We believe that these outcomes combined with the analysis and advices of coaches, can better improve the athletes' performances and style in general, and particularly will help in a near future all junior athletes in their progress.