# Correlation Between Kinovea Analysis and Accelerometric Analysis

The analysis of the video using Kinovea and the processing of raw accelerometer data via the Python script constitute a complementary study of jump performance, where dynamics (forces) explain kinematics (movement).

## Observations from Kinovea

The video analysis highlights the impact of arm movement on the jump :

— **Jump without arms :** Maximum height reached of **44.78** cm for a flight time of **0.57** s.

— **Jump with arms :** Maximum height reached of **55.71** cm for a flight time of **0.65** s.

The addition of arm movement allowed for a height gain of **10.93** cm (or approximately **24**% improvement) and an increase in flight time of **0.08** s. The jumper was therefore successful in propelling themselves faster off the ground thanks to their arms.

## Justification by the Python Code

The role of the Python code was to analyze the cause of this increase in flight velocity. The script isolates the push-off phase (détente) of the jump and focuses on acceleration to serve as a proxy for force.

— **Acceleration calculation :** The code calculates the magnitude of the Euclidean acceleration ($A = \sqrt{x^2 + y^2 + z^2}$) and subtracts $1g$ to isolate the acceleration related to movement, utilizing the fact that the sensor's $\mathbf{X}$ and $\mathbf{Y}$ axes (worn on the wrist) primarily measure the vertical component (see the section "Sensor placement and axis study" in the *notebook*).

— **Peak extraction :** The analysis (referencing cell 39 of the *notebook*) reveals that the maximum acceleration peak is significantly higher when the arms are used (the ratio of the peaks is calculated to be approximately **6.98** compared to the jump without arms).

According to the fundamental principle of dynamics ($\mathbf{F} = \mathbf{m} \times \mathbf{a}$), an increase in the acceleration ($a$) recorded during the push-off, for a constant mass ($m$), signifies that the jumper exerted a **greater net force ($F$)** against the ground.

## Synthesis and Implication

The increase in force measured by the accelerometer and the improvement in height measured by Kinovea are two sides of the same physical law, the impulse :

$$\text{Impulse} \left( \sum F \cdot \Delta t \right) = \text{Change in momentum} \, (m \cdot \Delta V)$$

The rapid and coordinated arm movement generates an additional vertical impulse. This increased impulse translates into a higher acceleration peak (quantified by the code) and, ultimately, a greater maximal take-off velocity ($\mathbf{V_0}$), thereby ensuring the better performance in height and flight time measured by Kinovea.