1 Introduction
Study of the dynamic interaction with the environment and loading of the human body is important in ergonomics, sports and rehabilitation. This paper presents a method to estimate power transfer between the human body and the environment during short interactions and relatively arbitrary movements using a combination of inertial and force sensing.

2 Methods
Power transfer between two bodies is given by:

\[ P = \vec{F} \cdot \vec{v} + \vec{M} \cdot \vec{\omega} \]  

(1)

Performed work follows by integrating power over time. Angular velocity \( \vec{\omega} \) can be measured using rate gyroscopes, velocity \( \vec{v} \) can be estimated from accelerometers after rotation to the inertial coordinate system, subtraction of gravitational acceleration, integration and applying adequate start and end conditions. Force \( \vec{F} \) and moment \( \vec{M} \) can be sensed by a 6 DOF force/moment sensor system [1] (Figure 1).

3 Results
An example result is shown in figure 2. The mass is transferred from the ground to a 75 cm high table, accounting for a potential energy change of 69 J. The estimated performed work in this case is 70 J.

4 Discussion
The presented method also allows partial characterization of the dynamic characteristics of unknown loads.

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References