FORCE PLATE

0364BT

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

http://www.cma-science.nl

Short description

The Force plate 0364 measures the forces of stepping, jumping and other human-scale actions, such as observing the change in normal force during an elevator ride, measure the impulse delivered by the floor during a jump.
The Force Plate has two ranges, one for larger forces up to 3500 N, and a more sensitive 800 N range for pushing experiments. The plate includes one pair of handles. They can be attached either to the top or the bottom of the force plate.
The Force plate can be directly connected to the analog BT inputs of the CMA interfaces.

Sensor recognition

The Force plate 0364 has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces. If your Force plate is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

Calibration

The Force plate is supplied calibrated. The output of the Force plate is linear with respect to the measured force. The calibration functions are:

Range −800 .. +3500 N: $F(N) = 1000 * V_{out}(V) - 1000$
Range −200 .. +800 N: $F(N) = 250 * V_{out}(V) - 250$.

The Coach software allows selecting the calibration supplied by the sensor memory (EEPROM) or the calibration stored in the Coach Sensor Library. For better accuracy you can perform manual calibration.

For better accuracy you can perform a manual calibration. For this method you can choose a value of zero (nothing on the force plate) and for a second calibration point put an object of know mass on the force plate. Make sure you choose an appropriate weight (at least 25% of the full scale that is used).

Suggested experiments

The force plate can be used in the following experiments:

- Analyze a crouched jump. Start with knees bent, hands on hips. Do NOT lower your body further; jump up only. Do not move arms. This very artificial jump is easier to analyze than a natural jump.
    - Use the impulse of the force to find the change in momentum; find the jumper's velocity at take-off to estimate the jump height.
    - Use the flight and kinematics to find the jump height.
    - From the force *vs*. time graph, determine acceleration *vs*. time graph. Integrate to find velocity and position *vs*. time graphs. Construct a plot of force *vs*. position, and use that to determine the work done on the jumper's center of

mass by the floor. Since that work shows up as kinetic energy, use the energy to find the velocity at take-off.

- Repeat the above analysis for a natural jump, beginning with standing straight, crouching down, and then jumping. You will be able to jump higher this way, but the analysis will be more complex.
- Do expensive running shoes measurably reduce heel strike force?
- Compare the measured impulse to the mechanical work done when lifting a large weight.
- Investigate the forces involved during the technique known as “unweighting” during ski or snowboard turns. Can you easily cut your apparent weight by a factor of two? Four?
- How does the force of your foot on the ground vary during walking?
- Investigate the forces developed by jumping onto the force plate.
- Hang the force plate on the wall and measure the reaction force as you lean on the plate. Does the wall push back on you?
- Take the force plate on an elevator ride. Stand on the force plate, and record the force of the elevator floor on your feet as a function of time. Explain. Can you determine the speed of the elevator from the data?

Technical Specifications

Sensor kind	Analog, generates an output voltage between 0 - 5 V
Measurement range	−800 .. +3500 N (positive value is compression force) −200 .. +800 N
Resolution using 12-bit AD converter	1.2 N (3500 N range) 0.3 N (800 N range)
Calibration function	F(N) = 1000 * V_{out} (V) − 1000 (3500 N range) F(N) = 250 * V_{out} (V) − 250 (800 N range)
Maximum non-damaging force	4500 N compression (evenly distributed) or 900 N pull (evenly distributed)
Dimensions	28 x 32 x 5 cm^3
Connection	Attached cable with right-hand BT (British Telecom) connector.

Warranty:

The Force plate 0364 is warranted to be free from defects in materials and workmanship for a period of 12 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

Note: *This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.*

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