At low [ATP], the motor rotates in 120° steps. At high [ATP], the rotation rate becomes continuous and saturates (with Michaelis/Menten kinetics) at 130 revolutions per second.
Hair cells found in the inner ear transduce sound via the stereocilia that project from their apical surface. As the stereocilia bundle moves in response to fluid oscillations in the cochlea, tension in the tip link (a fine filament connecting the tip of one stereocilium to the side of another) increases, opening an ion channel to initiate the electrochemical response.
Jumping robot
* mechanical design
* modelling and simulation
* control
* biomechanics

Humanoid Jumping Robot The aim of our research is to build a new human inspired structure of the lower extremity mechanism that will enable a humanoid robot to efficiently perform fast movements such as running and jumping. The biomechanics study of the human vertical jump showed the importance of the elastic biarticular muscles in performing the vertical jump. To prove our concept and theoretical findings, we designed a special human inspired robot that is able to perform the vertical jump and several acrobatic movements.
Control of ZMP and COG

Visualisation of a jump

Stable crouch

First successful jump

Sometimes (usually) things go wrong
Moving (orienting) an object with Mitsubishi Pa-10 robot
Moving (orienting) an object with a humanoid robot Armar III
Knee movement measurement

* control
* biomechanics

**Measurement of knee movement** The aim of the project is to determine exact motion of human knee. We have used an industrial robot to bend a knee and to measure positions of the knee during motion. In order to measure loaded or unloaded knee the robot has to be force controlled. To increase accuracy of the measurement we have developed autonomous force sensor gravity and offset compensation.
Selected Biomechanical Issues of Brain Injury Caused by Blasts

1. FEM blast analysis to measure the waves. Outcome: Profile of pressure distribution.

2. ATB rigid body analysis of the body exposed to blast waves. Outcome: Head acceleration (3 linear, 3 angular)

3. FEM Brain tissues analysis. Outcome: Stress/strain characteristics of the brain tissue.

4. Multiscale cellular analysis. Outcome: Effect of blast originated impulse on cellular damage (solid mechanics approach)

5. Cavitation. Outcome: Effect of blast originated impulse on micro damage due to cavitation inception in nano scale structure (fluid dynamics approach)

Flow chart of blast injury analysis
The energy expenditure in children during walking. The energy expenditure in children during walking.
### Dimension System

**Seven Fundamental Quantities**

<table>
<thead>
<tr>
<th>Unit Name</th>
<th>Unit Name</th>
<th>Unit Symbol</th>
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<tr>
<td>Length (L)</td>
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<td>m</td>
</tr>
<tr>
<td>Mass (m)</td>
<td>kilogram</td>
<td>kg</td>
</tr>
<tr>
<td>Time (T)</td>
<td>second</td>
<td>s</td>
</tr>
<tr>
<td>Electric Current</td>
<td>ampere</td>
<td>A</td>
</tr>
<tr>
<td>Temperature</td>
<td>degree of Klevin</td>
<td>°K</td>
</tr>
<tr>
<td>Luminous Intensity</td>
<td>candela</td>
<td>cd</td>
</tr>
<tr>
<td>Amount of Substance</td>
<td>mole</td>
<td>mol</td>
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</table>
Dimensionless Quantities

- percentage
- percentile
  - the 5th percentile
  - the 25th percentile = 1st quartile
  - the 50th percentile = 2nd quartile (median)
  - the 75th percentile = 3rd quartile
  - the 95th percentile
  - the 99th percentile
  - the 100th percentile = 4th quartile

Standard Prefix

<table>
<thead>
<tr>
<th>Name</th>
<th>yotta</th>
<th>tera</th>
<th>giga</th>
<th>mega</th>
<th>kilo</th>
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<tr>
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<td>G</td>
<td>M</td>
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<table>
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<td>$10^{-6}$</td>
<td>$10^{-9}$</td>
<td>$10^{-12}$</td>
<td>$10^{-24}$</td>
</tr>
</tbody>
</table>
• Derived Quantities

- Displacement \( (d) \)
- Velocity \( (v) = \frac{dx}{dt} \)
- Acceleration \( (a) = \frac{dv}{dt} \)
- Angular velocity \( (w) = \frac{dq}{dt} \)
- Force \( (F) = ma \)
- Moment of force \( (M) \): Torque \( = Fd \)
- Work \( (W) = Fd \)
- Power \( (P) = \frac{W}{t} \)
- Energy \( (E) = mc^2 \)
- Momentum \( = mv \)
- Area \( (A) \)
- Volume \( (V) \)
- Density \( (D) = \frac{m}{V} \)
- Pressure \( (P) = \frac{F}{A} \)
Comparison of various scalar and vector quantities in biomechanics. Vector quantities must specify magnitude and direction.
Nine Principles for Application of Biomechanics

The nine principles of biomechanics can be classified into those related to movement of the body or a projectile. The human body can be a projectile, so all nine principles can be applied to the human body.

The principles can be organized (Figure 2.5) into ones dealing primarily with the creation of movement (process) and ones dealing with the outcome of various projectiles (product).
A free-body diagram of a person quietly standing. The major vertical forces acting on the person (gravity and ground reaction force) are illustrated, while horizontal forces are small enough to ignore.