Locomotion Seminar

A functional perspective on legged locomotion

Srideep Musuvathy

Legged Locomotion

- Wasn't the wheel the greatest revolution in the history of invention?
- Most forms of 'higher' animals use legs for terrestrial locomotion
- Wheels need roads or tracks! That makes a lot of places inaccessible

Advantages of legs

- Isolated footholds
- active suspension
- consider examples of rugged terrain, mountains, swamps, loose gravel, sands, volcanic ash(!?!), etc

Structure, Dynamics and Balance

- Geometric structure and kinematic issues
  - gaits
  - stable vs unstable structures
  - structure of legs and joints
- Dynamics and control issues
  - forces and energy

Static vs. active balance

- static and dynamic equilibrium
- advantages of active balance
  - wider variety, higher speeds (ballistic motion), vertical accelerations
- inverted pendulums, acrobot, under-actuated control

Studying one legged hopping machines

- hopping and running is the same in here
- research in gaits
- will studying this help us understand more complex legged locomotion?
- Stance and Flight -- what are they?

Decomposing the control scheme

- Hopping
- Forward Speed
- Posture

locomotion in three dimension

- planar motion in sagittal plane
- the ‘plane of motion’ (Murthy) - forward velocity vector and gravity vector
- Extraplanar degrees of freedom can be controlled using the above mentioned scheme

More legs

- more legs = sum of many single legs?
- concept of ‘virtual legs’
- problem becomes complex when there is more than one leg doing active balance

Symmetry

- for constant velocity, instantaneous acceleration must integrate to zero.
- This is achieved by using odd symmetry
- widely used in robots and animals

take home message

- active balance
- decomposition
- one legged locomotion