Bipedal Running:
When Leg Architecture Influences Speed, Efficiency and Robustness.

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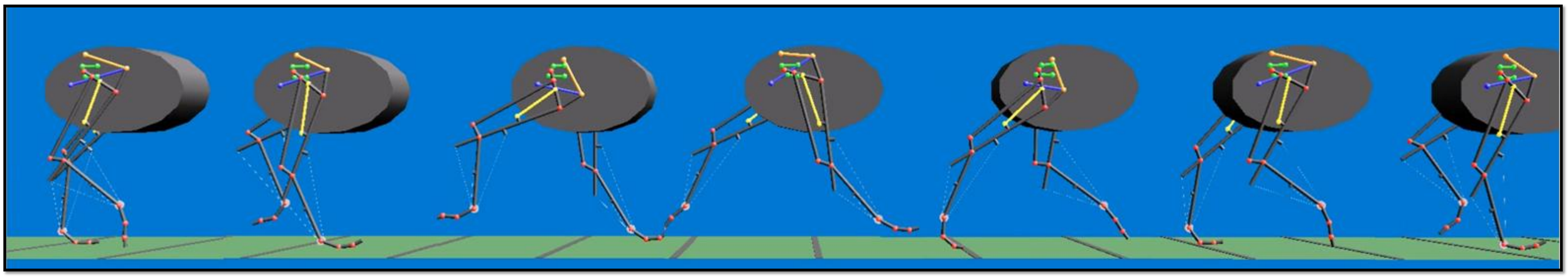


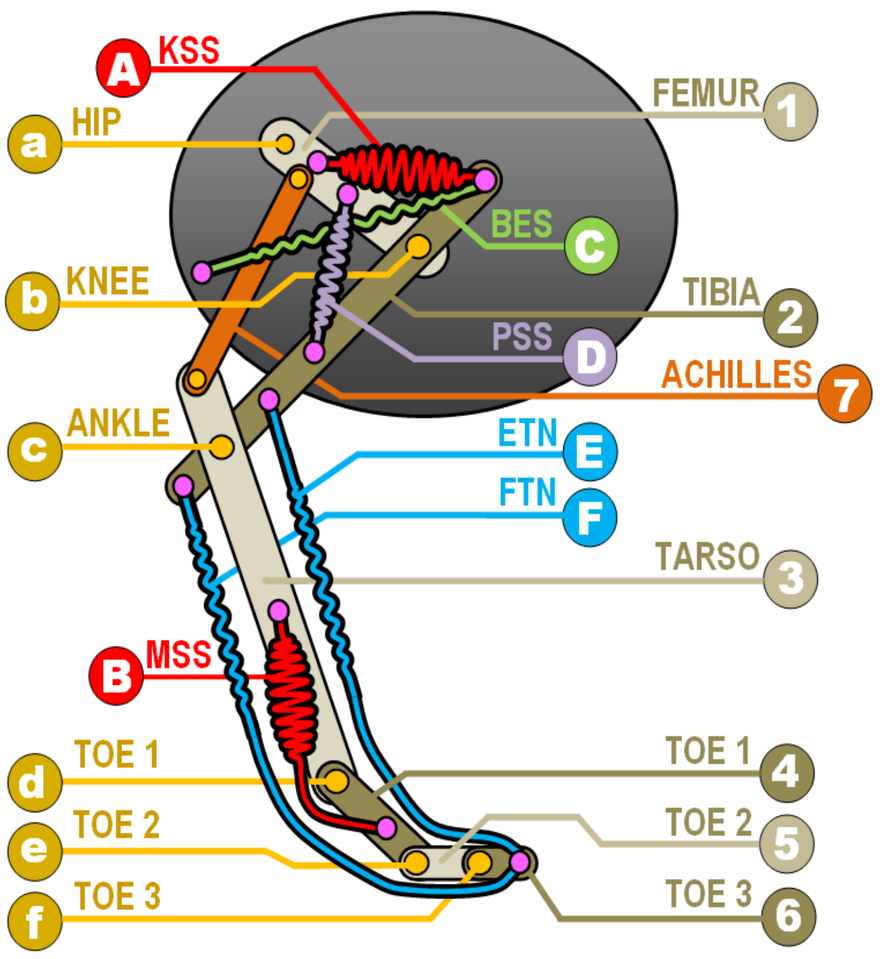
FastRunner is a planar bipedal robot based on a new bio-inspired leg architecture. Simulation results of FastRunner demonstrate that legged robots can be fast, energy efficient and inherently stable. Top speed reached is 50 kph. Lower cost of transport recorded is 0.5 while running at 32kph.

Mechanical Intelligence embedded in the leg allows for self stabilization property and reduces the burden for control. Only a closed loop sinusoidal trajectory at the hip is used to reach running speed. Compliant elements are used to absorb disturbances while running.

Non-linear Elastic Elements are used throughout the design to enhance the leg motion over a large range of speeds.

Only One Actuator per leg is used, supplying torque at the hip joint.

A Dual State Suspension allows the leg for exhibiting two dynamic modes. One during stance, when the suspension is engaged, storing energy and then converting it kinematically into forward thrust. Another during swing, when the suspension is disengaged facilitating the leg contraction and minimizing energy requirement to swing the leg forward .



FastRunner Leg Architecture

FastRunner Mechanical Design V1.0

A Velocity Amplifier mechanism is used to passively actuate the ankle joint and amplify the speed of the feet. This amplifier is created with a four bar mechanism creating a 1:2 transmission ratio between the knee and the ankle.

Tendon Networks are used to passively actuate the toes. These are made of 3 segments allowing for a rolling motion of the feet minimizing the need for active ankle torque and smoothing the center of mass trajectory.

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