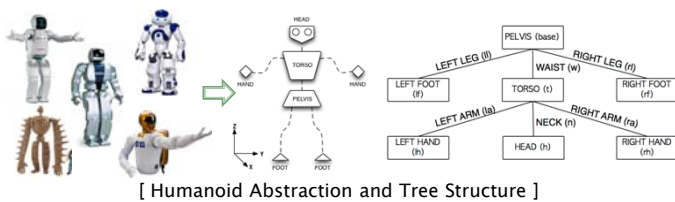


Motion Programming Environment for Humanoid Robots

Objective

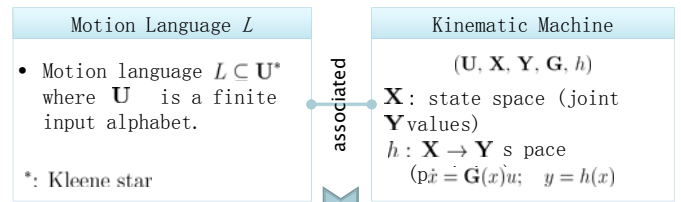
- Developing Motion Programming Environment
 - Specified for humanoid robots and not limiting their kinematic structure,
 - Describing motions independently to kinematic structure with expressiveness,
- Vertically integrated from low-level to high-level equipped with error detection at each level,
- Providing a handy measure for programming humanoids, avoiding starting from scratch.

Humanoid Modeling

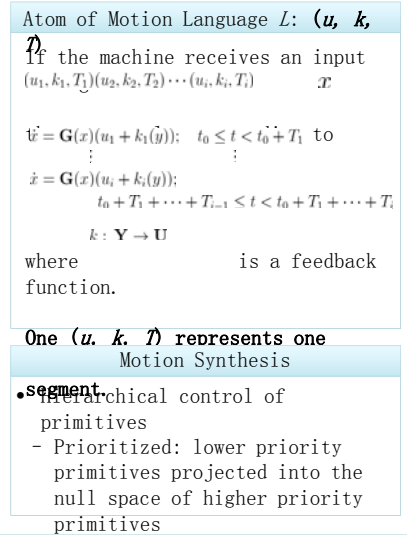
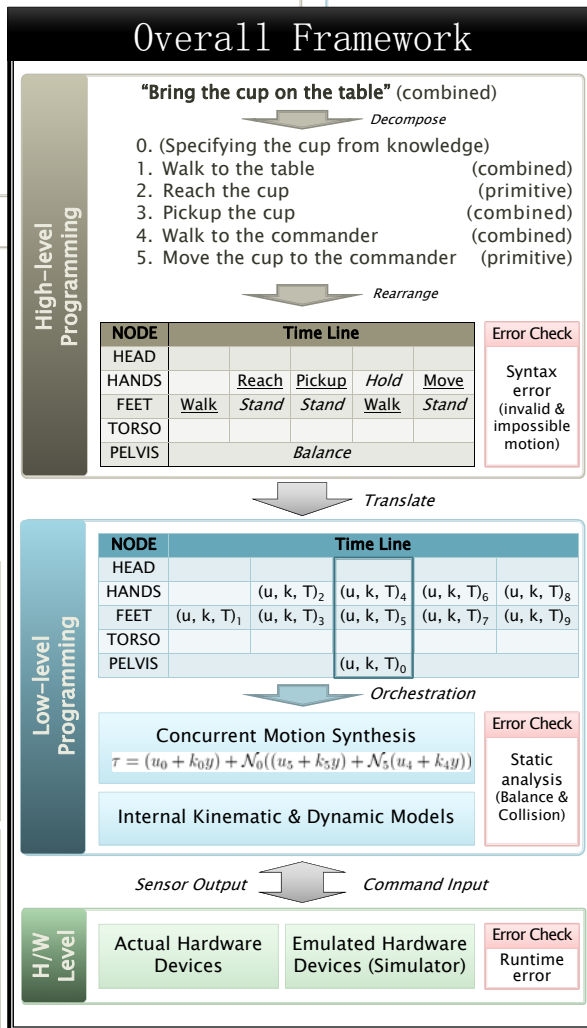


- Nod-Edge Structure
 - Node: **Topologically essential** body parts which are **subjects for motion** commands.
 - Edge: **Arbitrary kinematic Chains** connecting two distinguished nodes.

Motion Description Language

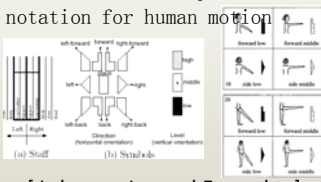


Overall Framework



Motion Primitives

- A set of motion alphabet constructing complex behaviors.
- Should be
 - Able to describe motions independent to kinematic structure,
 - Expressive enough to depict everyday chores.
- More complex motions can be expressed as combination of primitives.
- Two kinds of motions:
 - Free-space Motion (inspired by Labanotation): Graphical notation for human motion

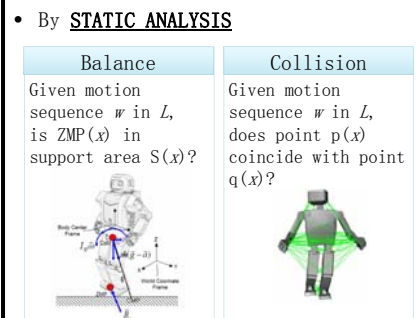


- Occupational Task (inspired by MTM (Method-Time Measurement)):
- Computes the mean time required to perform an occupational task by decomposing a task into primitives,
 - Is proven at decomposition.

Motions	Subjects	Arguments	Control Policy
Reach	Head Torso Hand, Foot	Direction, Level, Contraction or Position vector	Position Control
Move	Hand	Position vector, Force direction	Force/position control
ApplyForce	Hand, Foot	Force direction and magnitude	Force control
Crank	Hand	Center, Radius, Revolution	Force/position Control
Grasp	Hand	×	
Release	Hand	×	
Position	Hand	Position vector, Force direction	Force/position Control
Support	Foot	×	Position Control

[Table of Motion Primitives]

Validation



Simulation

