Computer Animation Algorithms and Techniques

Figure Animation

Vitrual Human Representation

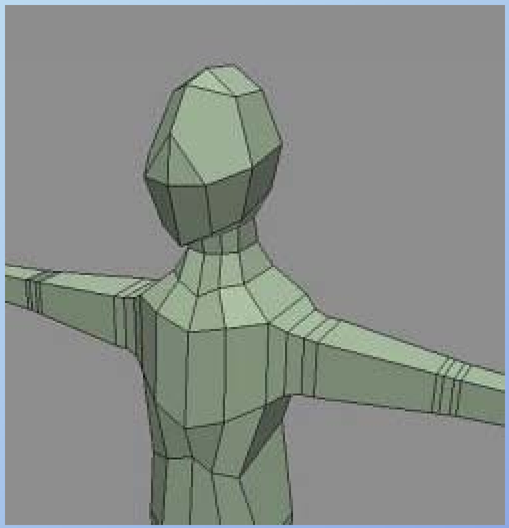
Body Modeling
Geometric representation
level of detail
DoFs
accessories: hair, clothes
rigid v. flexible

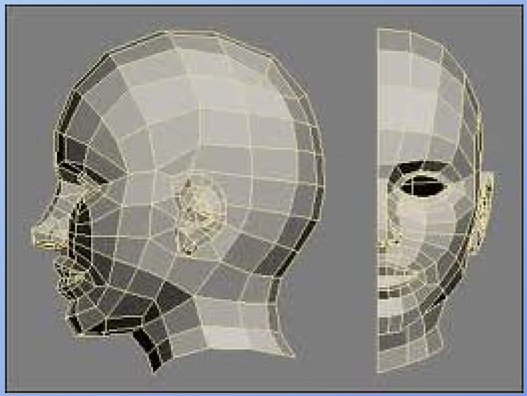
Activities
upper body tasks: reaching, grasping
locomotion: walking, running
body language: stance, gestures

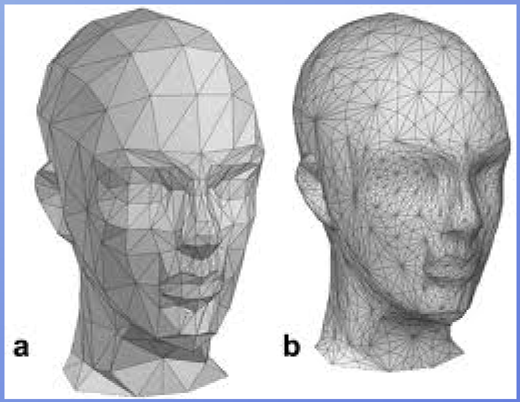
Secondary motion
upper body tasks: reaching, grasping
locomotion: walking, running
body language: stance, gestures

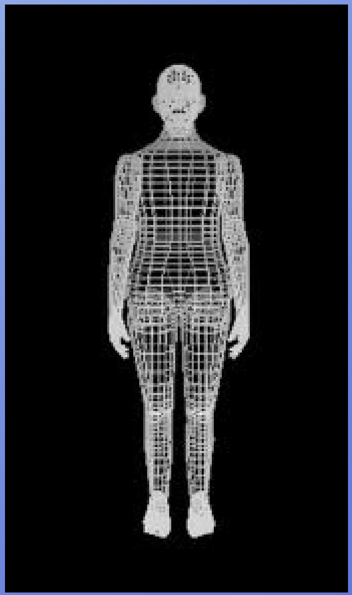
Body Modeling - Geometry

Polygonal representations

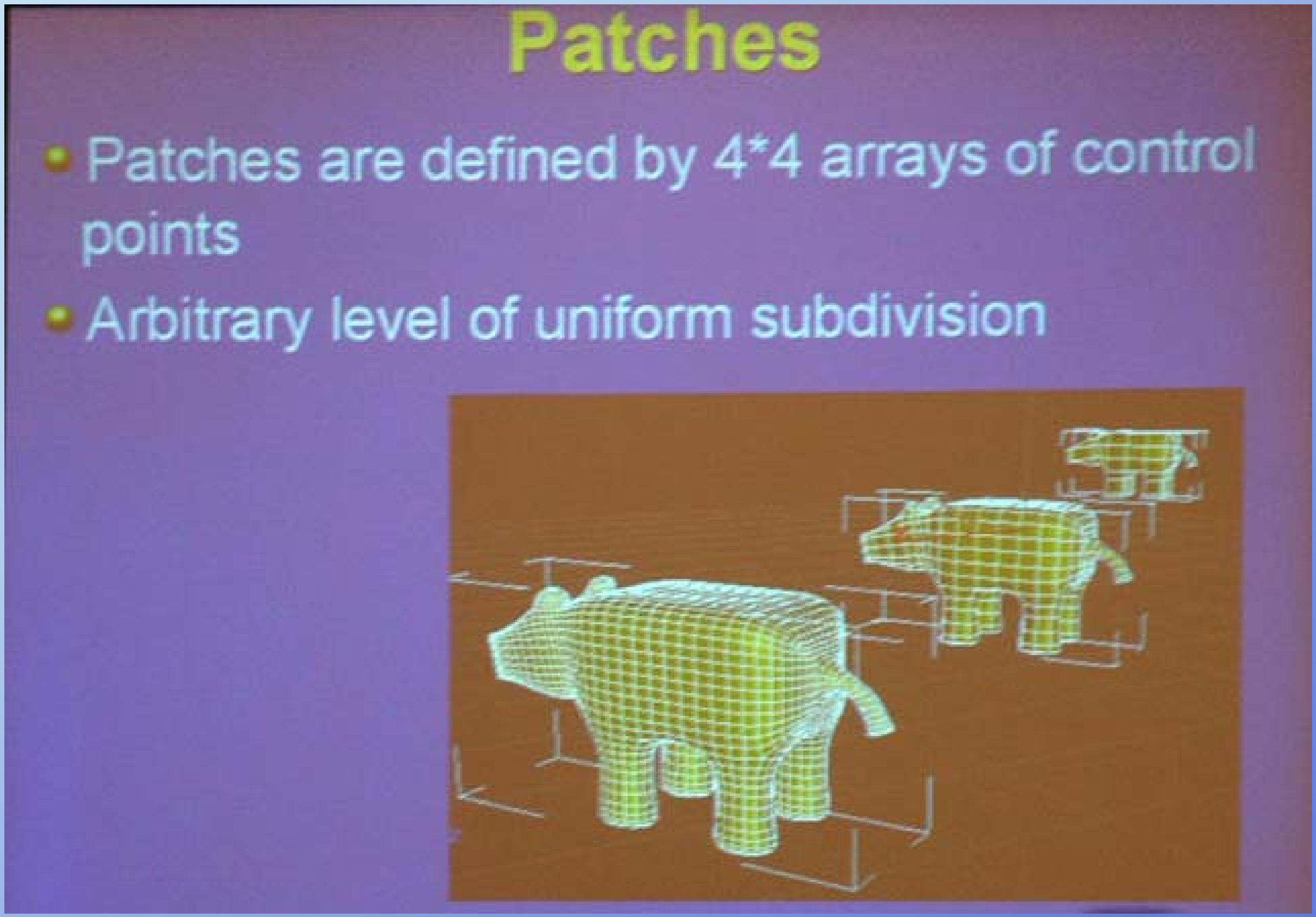






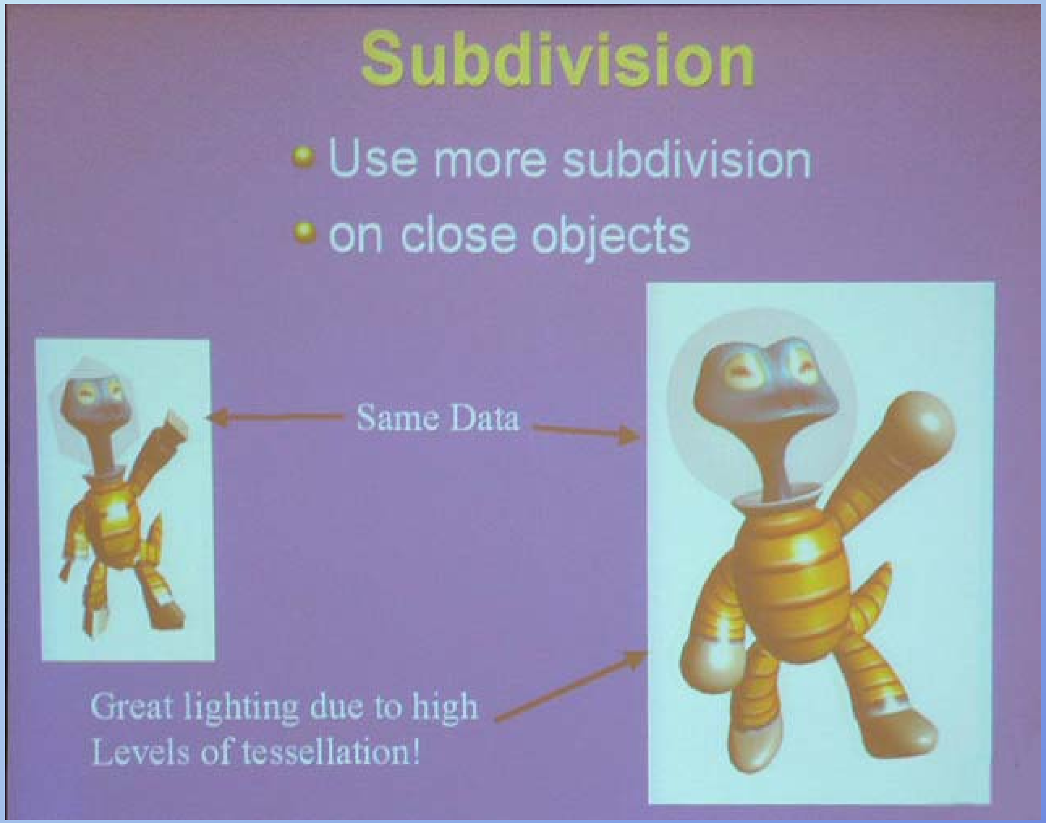


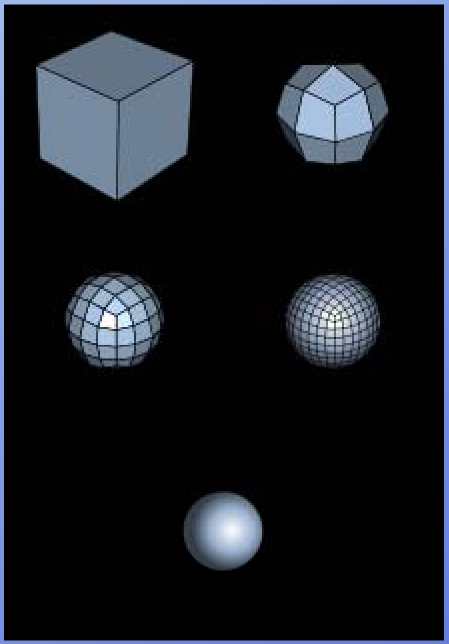
Body Modeling - Geometry



Body Modeling - Geometry

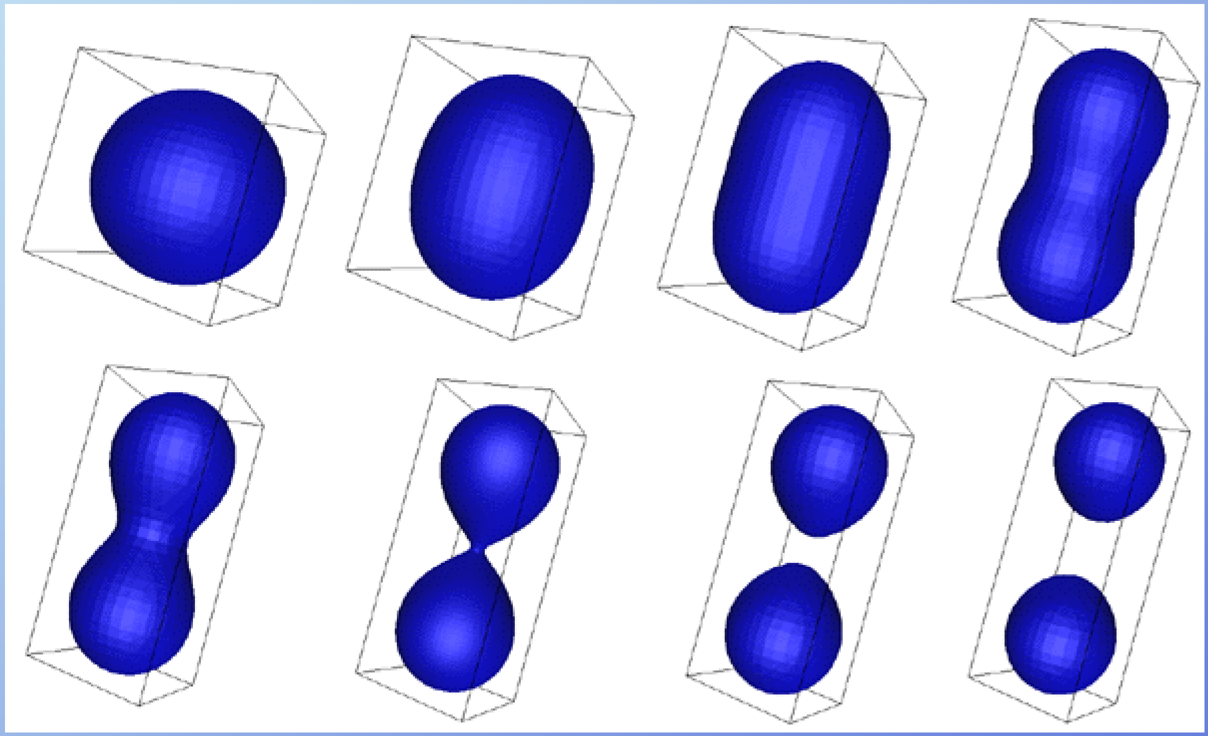
Subdivision surfaces





Body Modeling - Geometry

Implicit surfaces

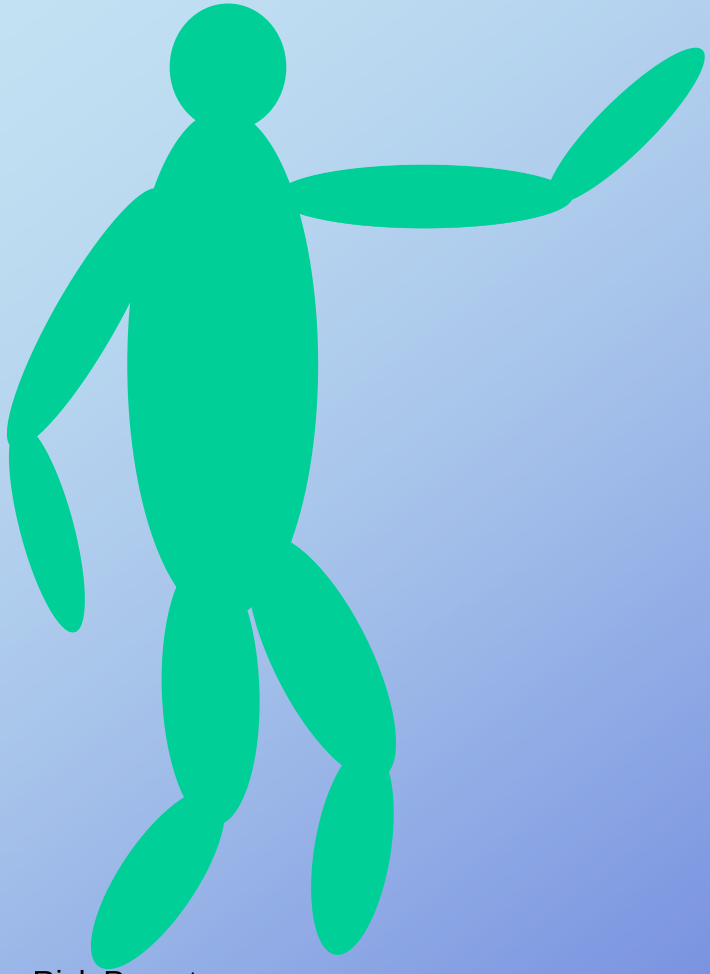


Body Modeling - Geometry

Body scan

http://www.cyberware.com/

Animation- Rigid Links

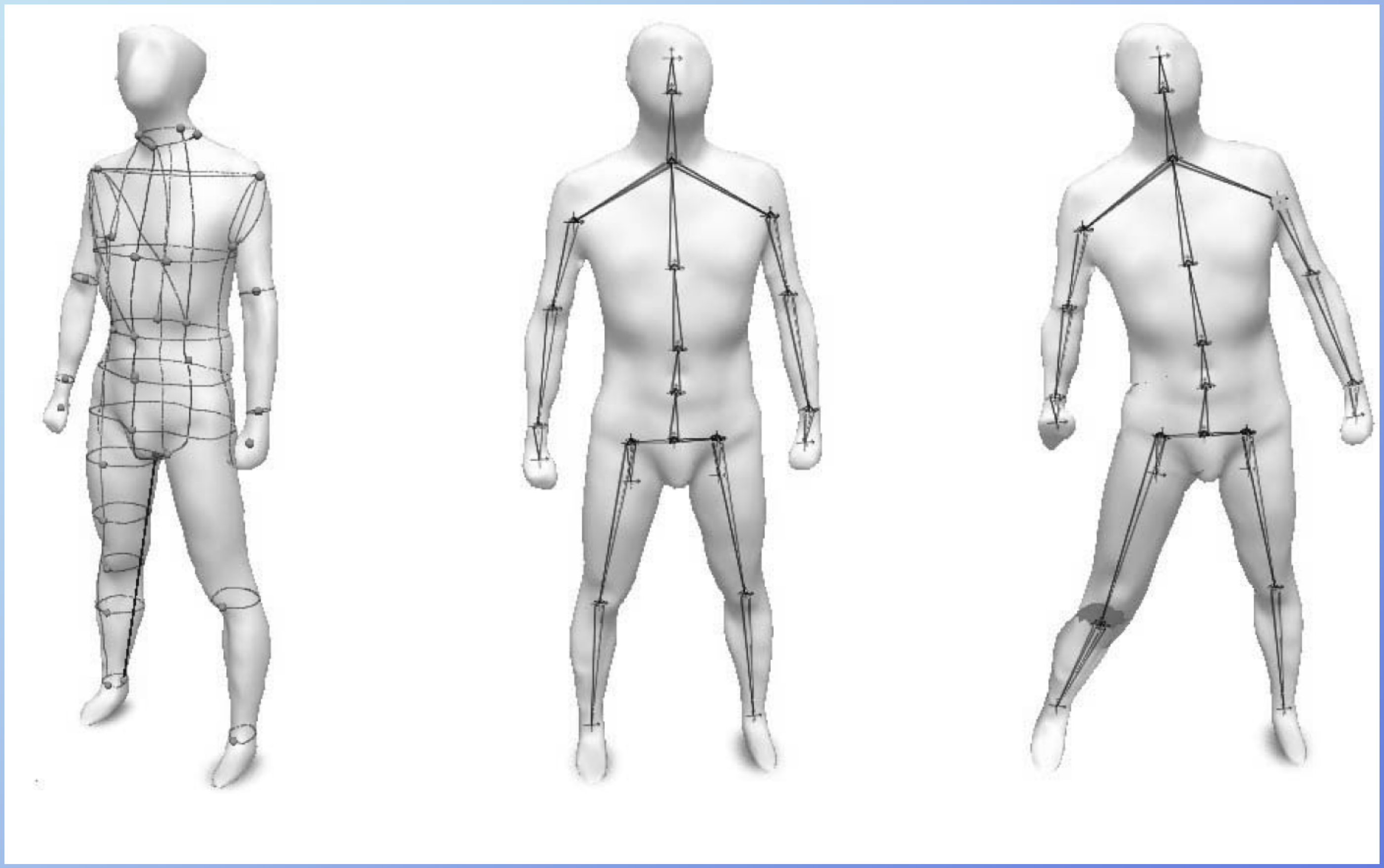


Hierarchical animation

Use FK or IK to animate

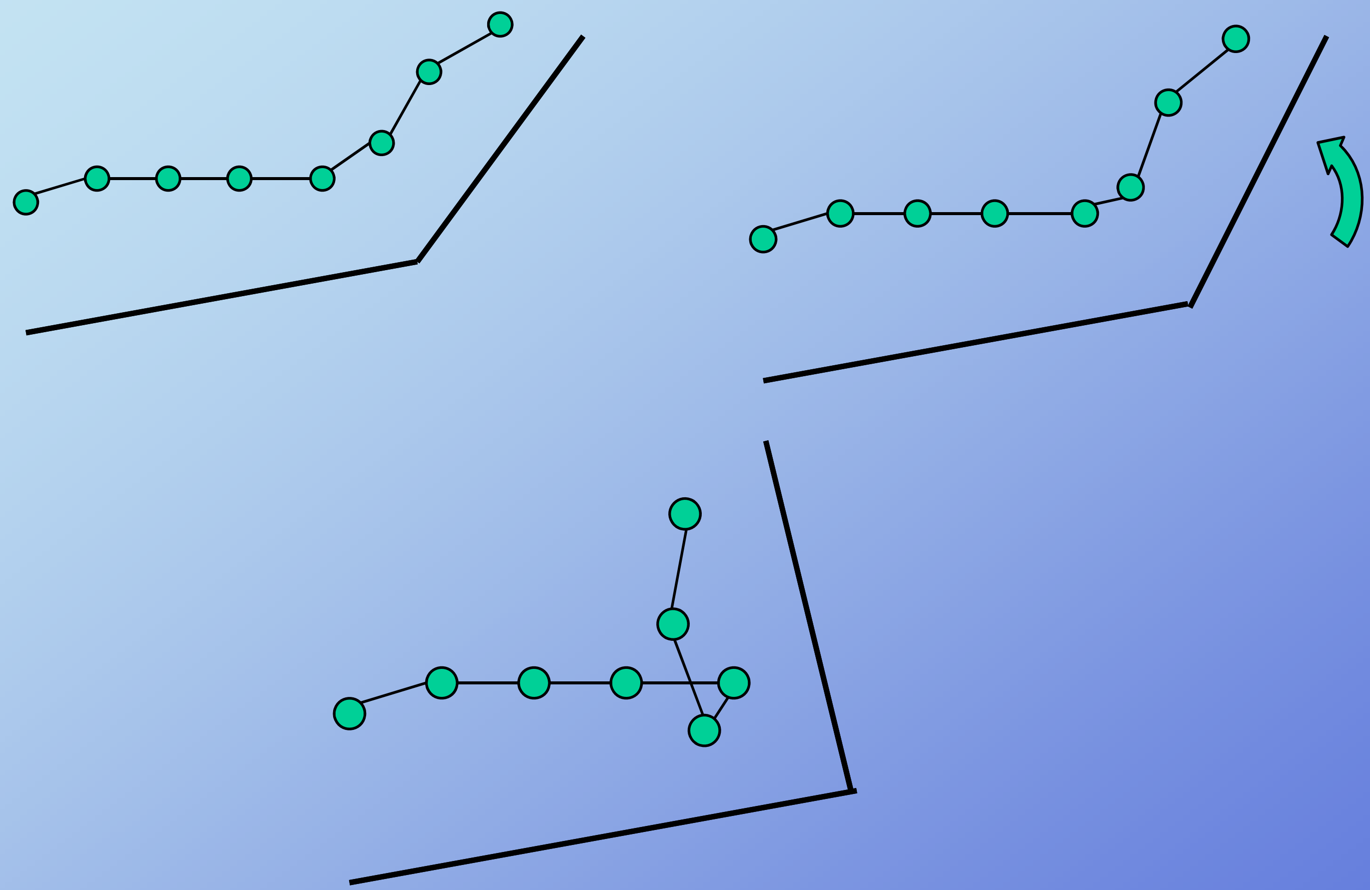
Interpolate between key frames

Animation – Skeleton Driven

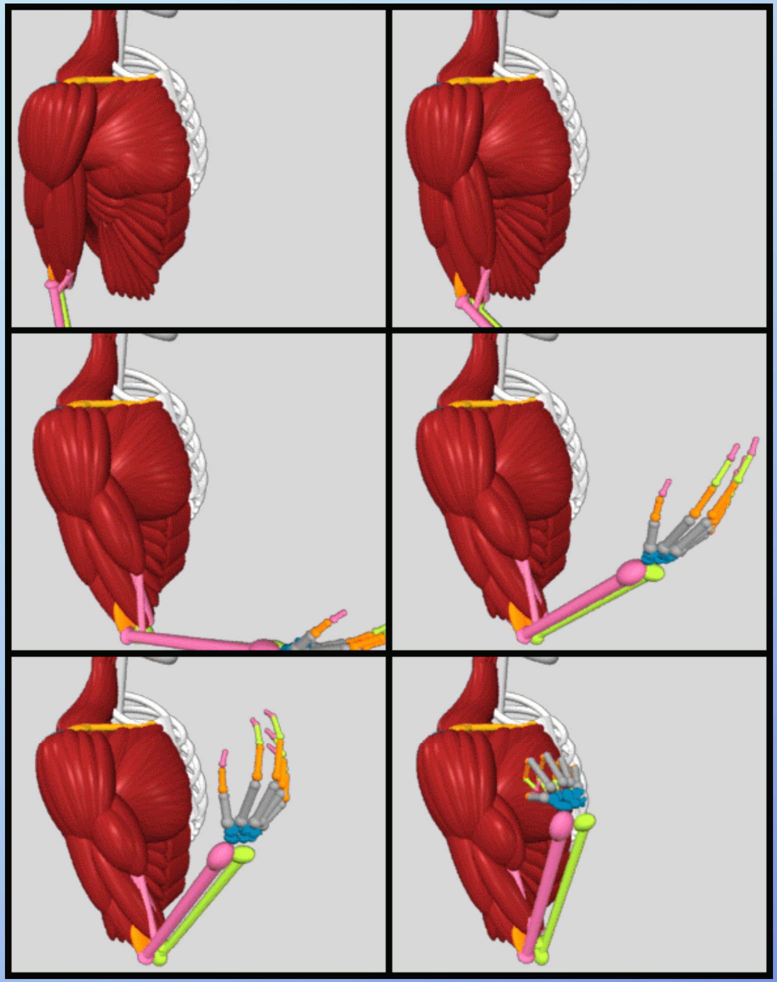


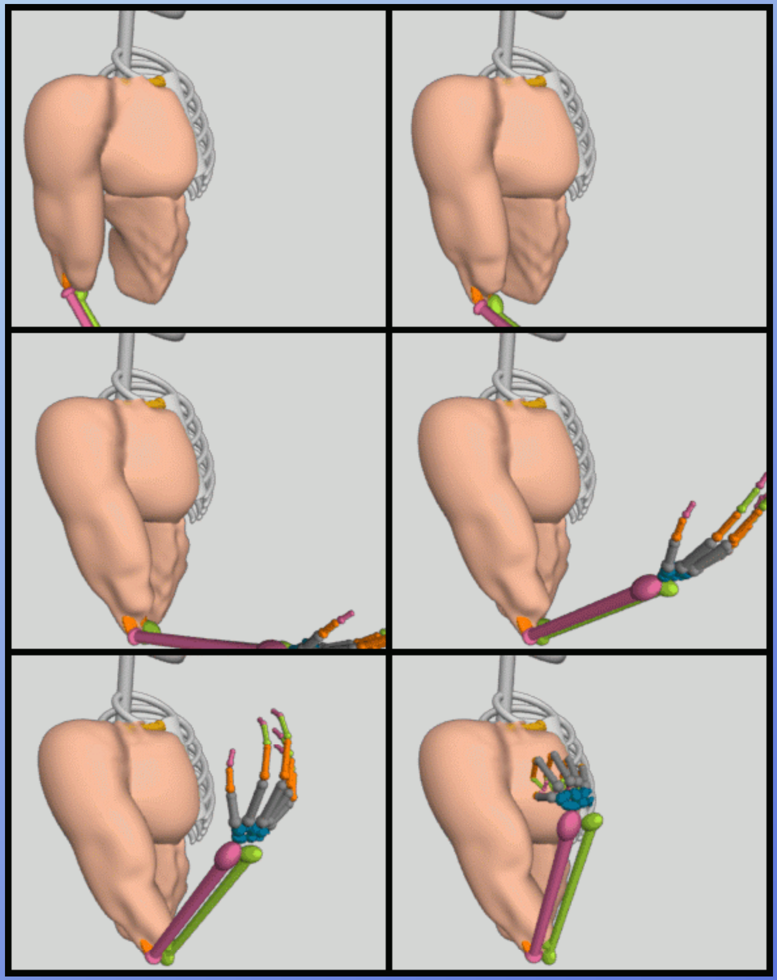
http://www.emeraldinsight.com/journals.htm?articleid=1532798&show=html

Animation - Skeleton Driven



Animation– Layered Approach

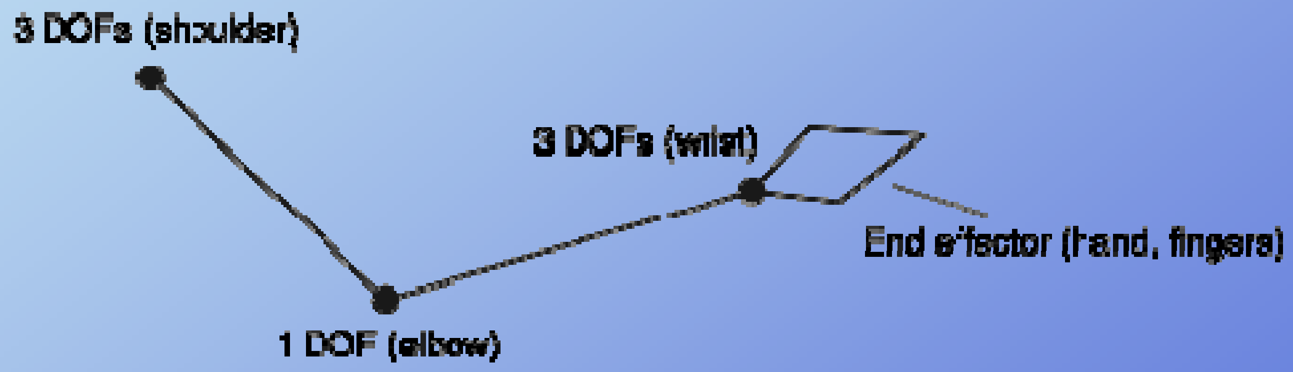




Reaching

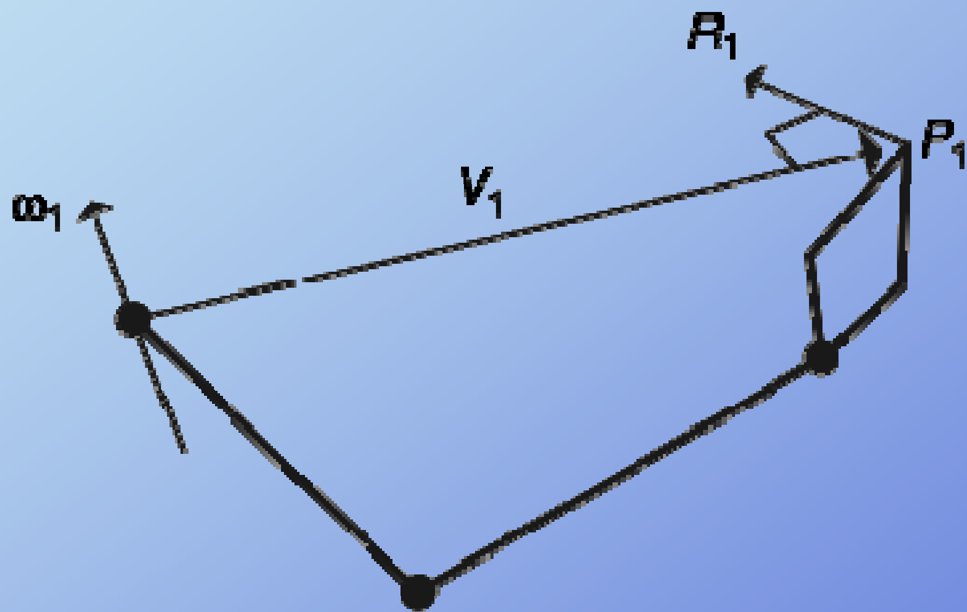
Modeling the arm
The shoulder joint
The hand
Coordinated movement
Obstacles
Strength

Modeling the Arm

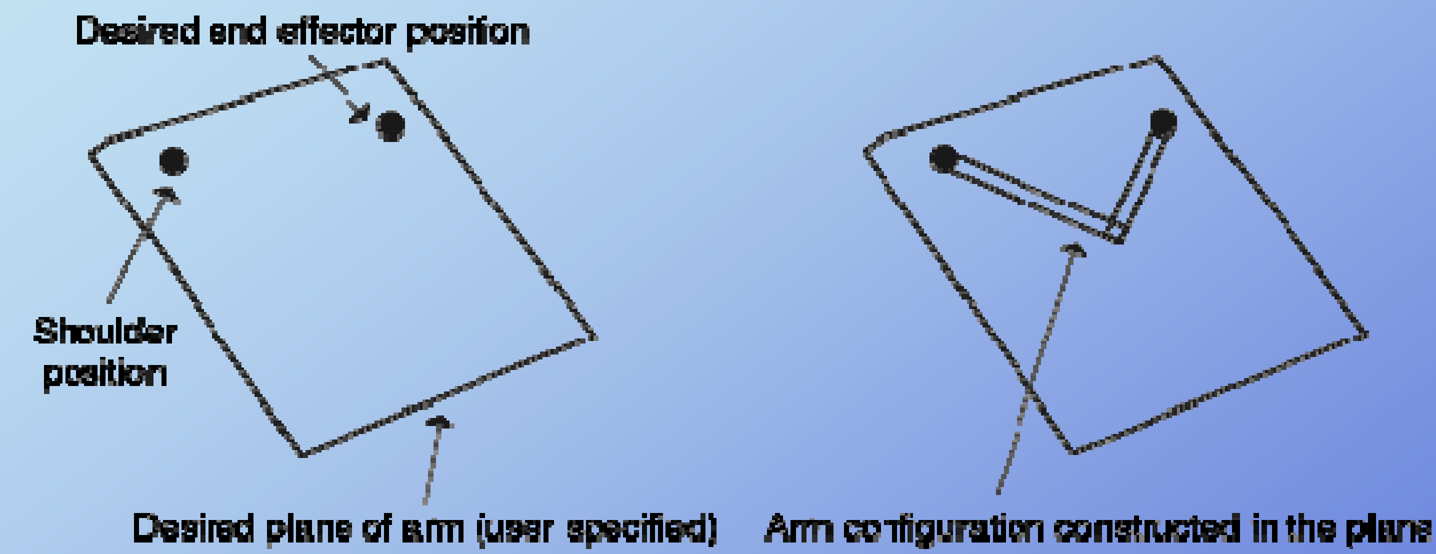


Also used is 3-2-2 DoF

Modeling the Arm

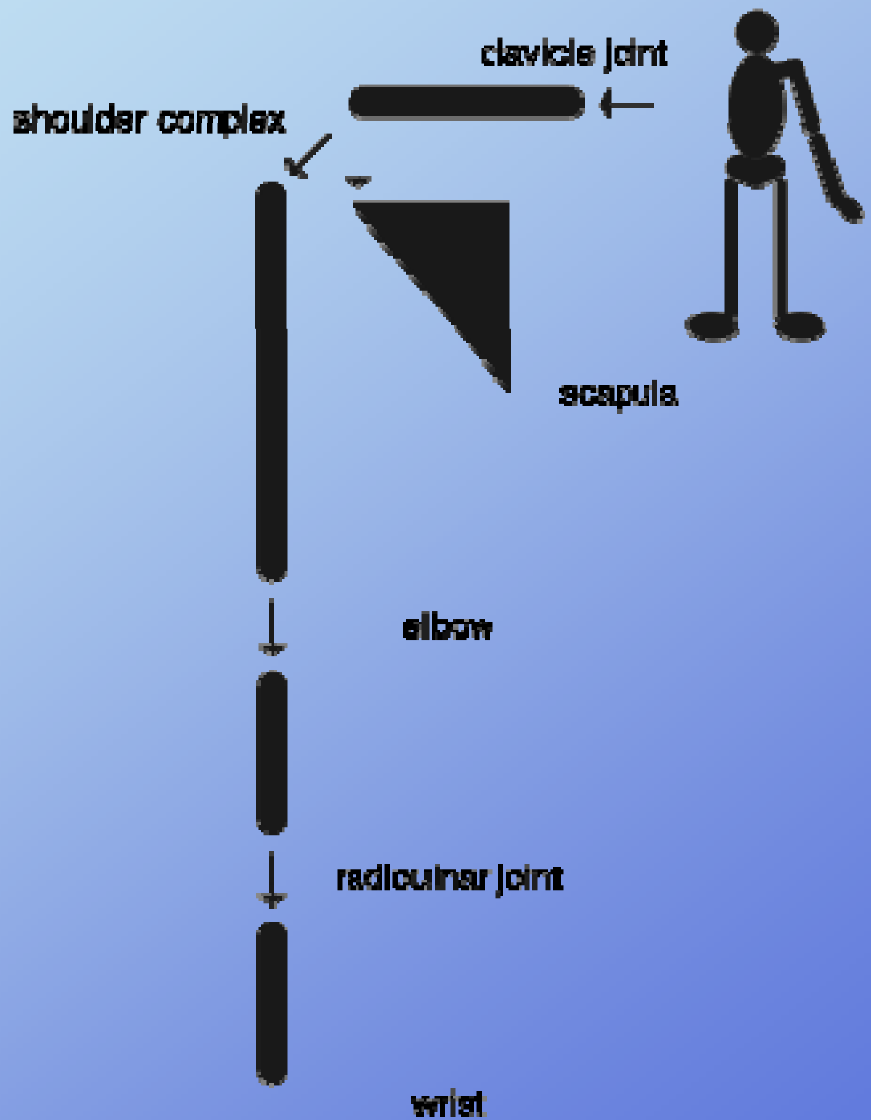


Modeling the Arm

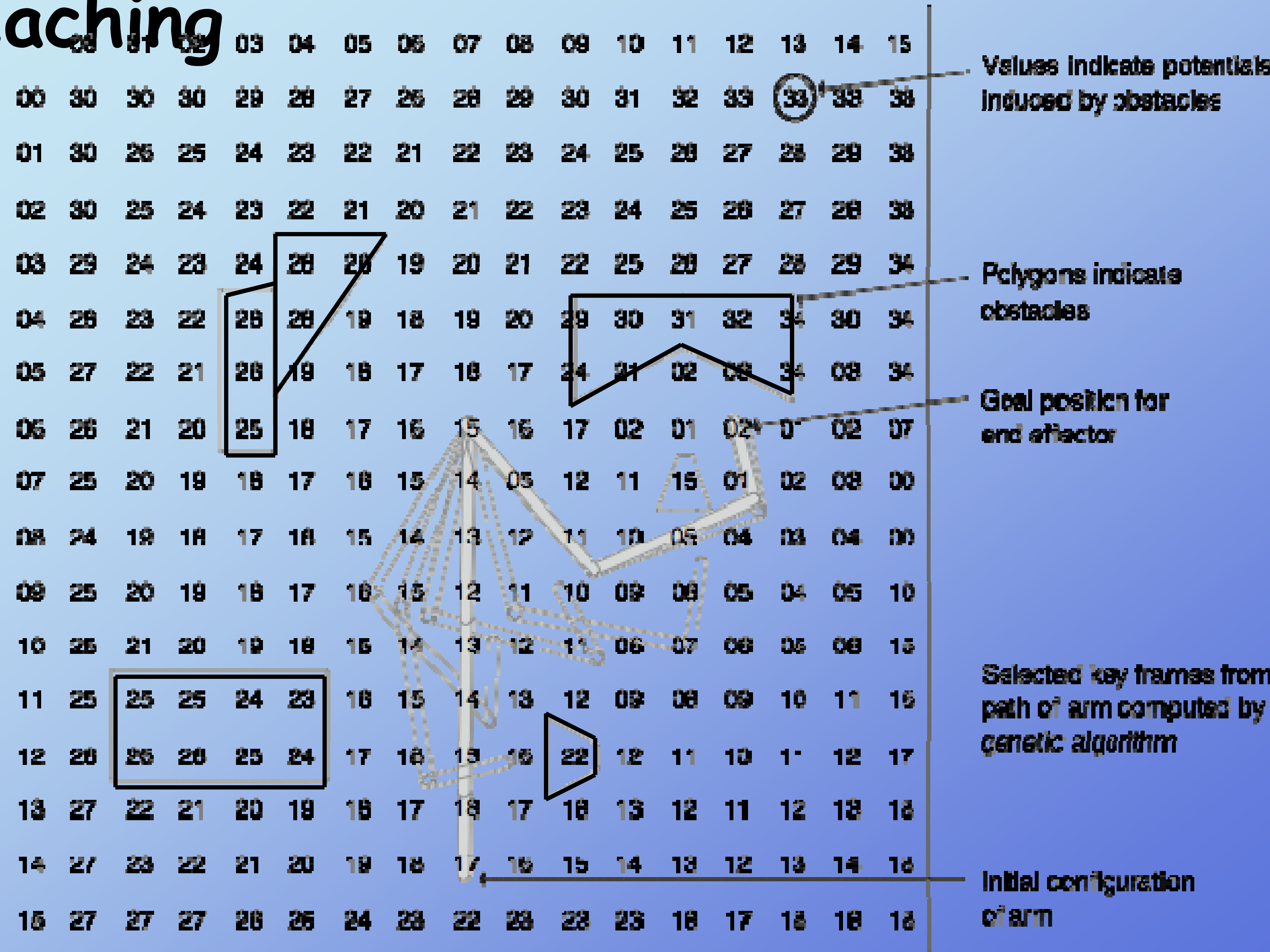


Determine plane of motion (3 DoF)
then 1-1 DoF arm
Then 2/3 DoF wrist

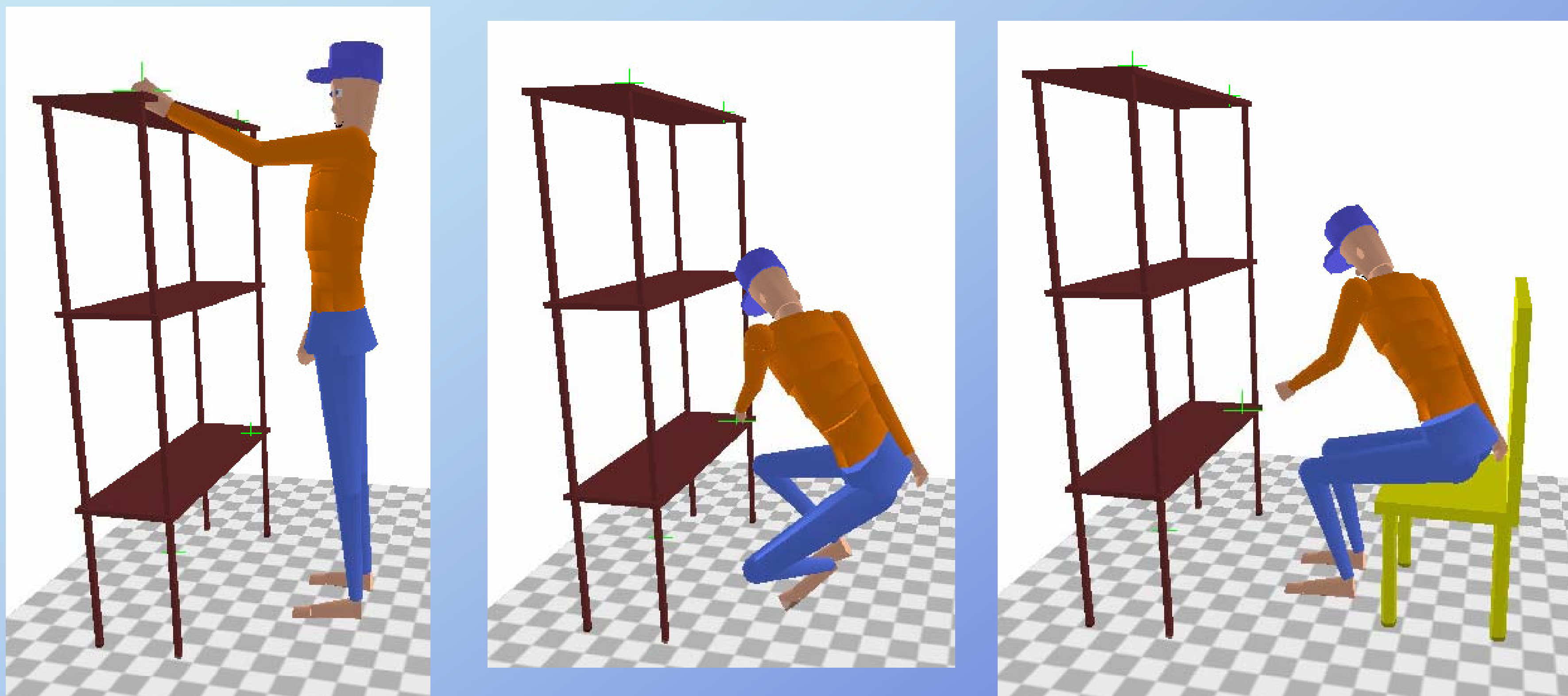
Modeling the Shoulder



Reaching

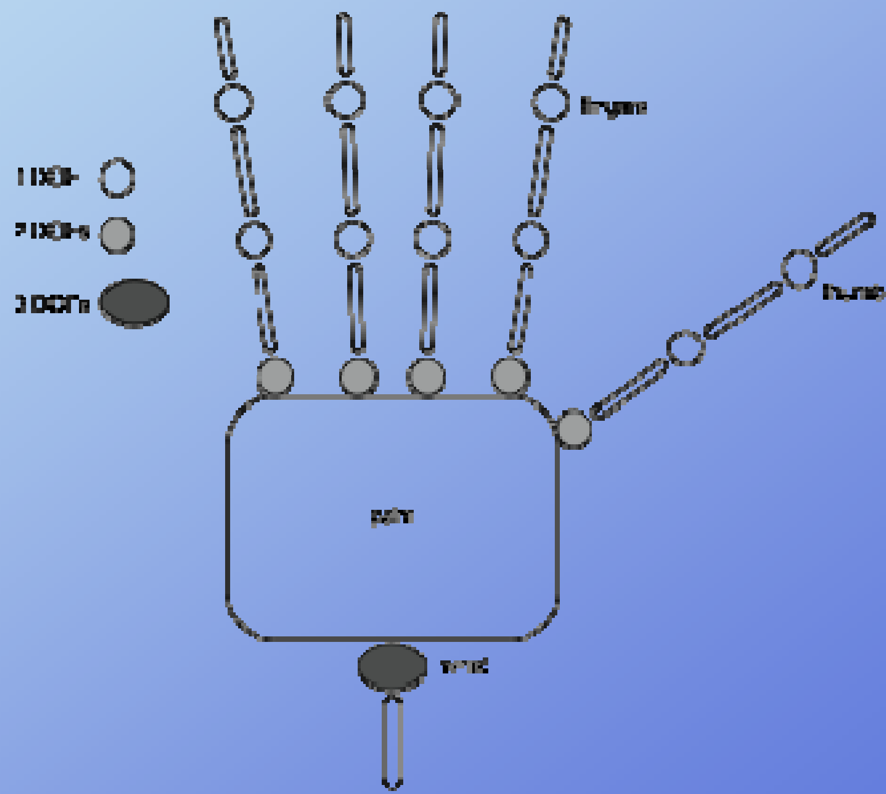


Values indicate potentials induced by obstacles
Polygons indicate obstacles
Goal position for end effector
Selected key frames from path of arm computed by genetic algorithm
Initial configuration of arm

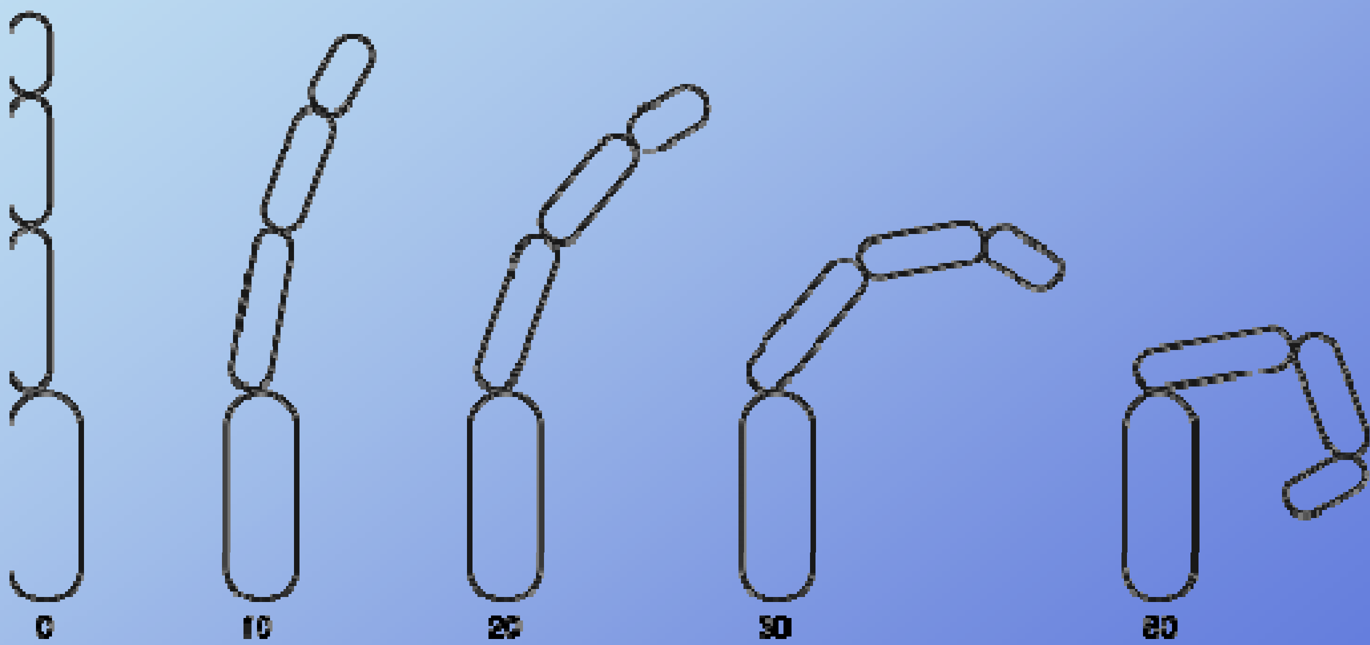


Approximating Human Reaching Volumes Using Inverse Kinematics
I. Rodrígueza, M. Peinadoa, R. Boulicb, D. Meziata
inma@aut.uah.es, manupg@aut.uah.es, ronan.boulic@epfl.ch, meziat@

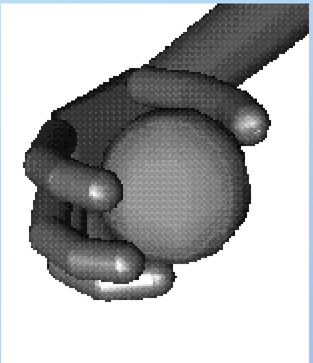
Modeling the Hand

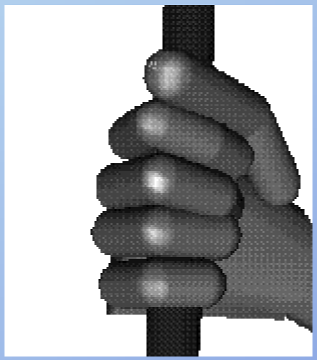


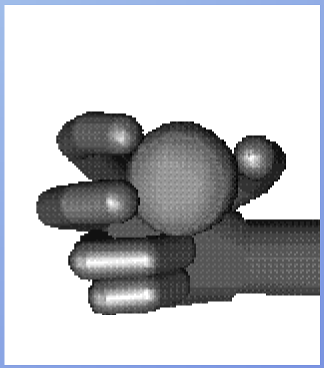
Grasping



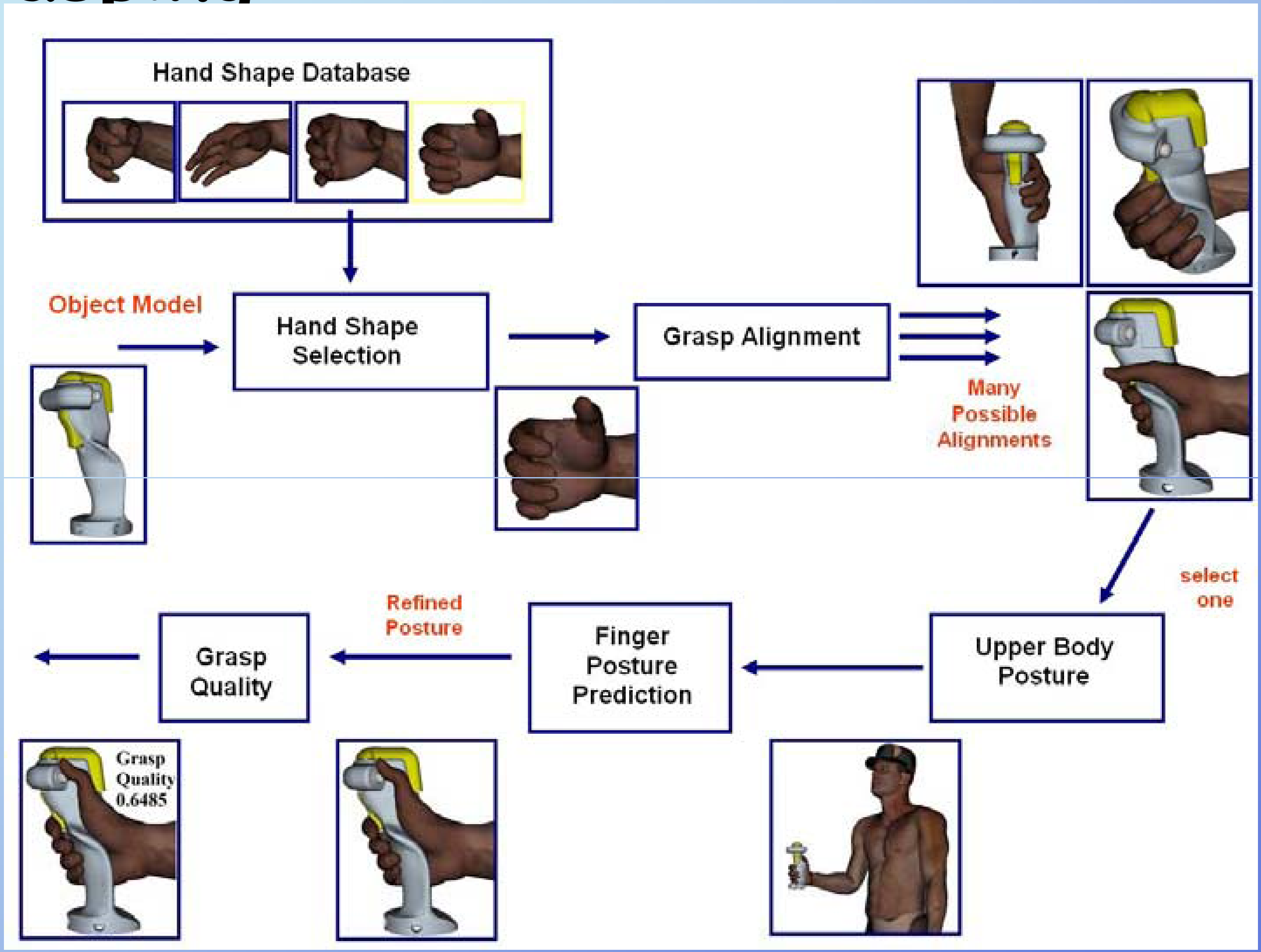
Grasping







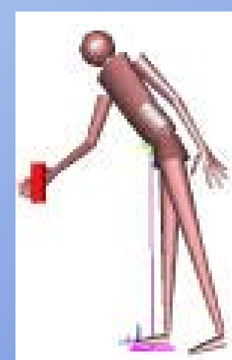
Grasping

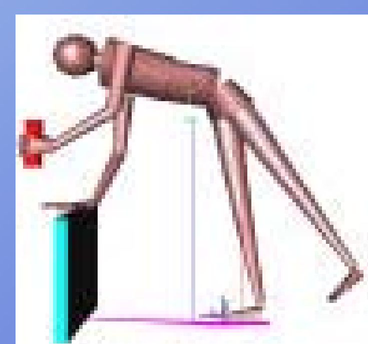


Grasp planning for digital humans
Faisal Amer Goussous, U. of Iowa

Reaching – close v. distant

Extended grasping behavior for Autonomous Human Agents
R. Max, R. Boulic, D. Thalmann



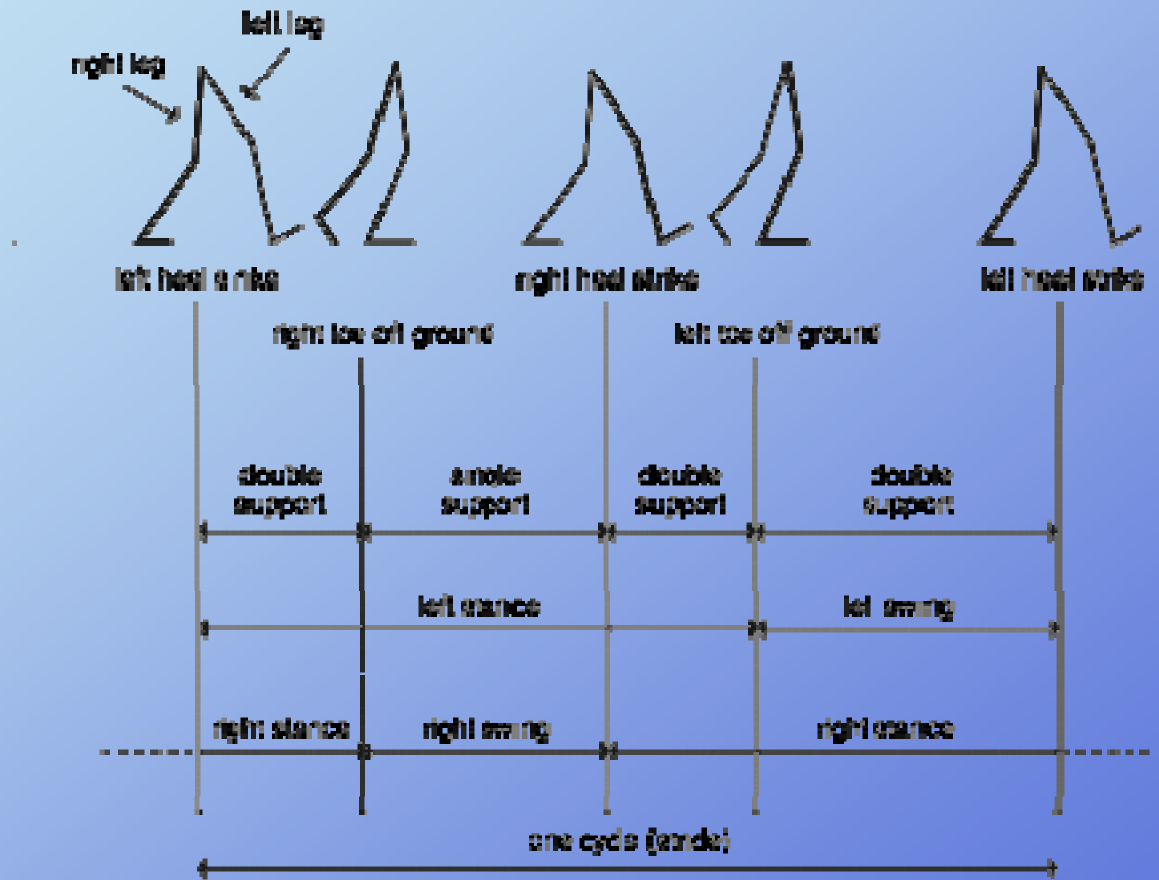


Mechanics of locomotion

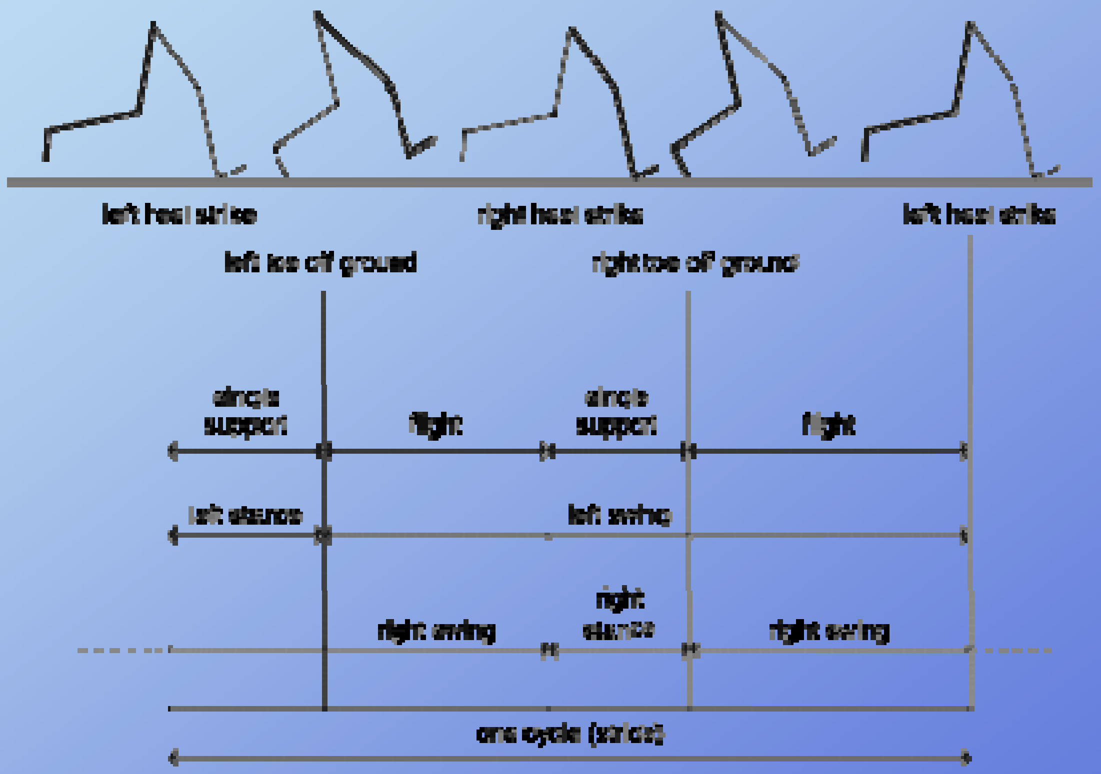
walk cycle v. run cycle

Pelvic transport
Pelvic rotation
Pelvic Tilt
Knee flexion
Ankle and toe joints

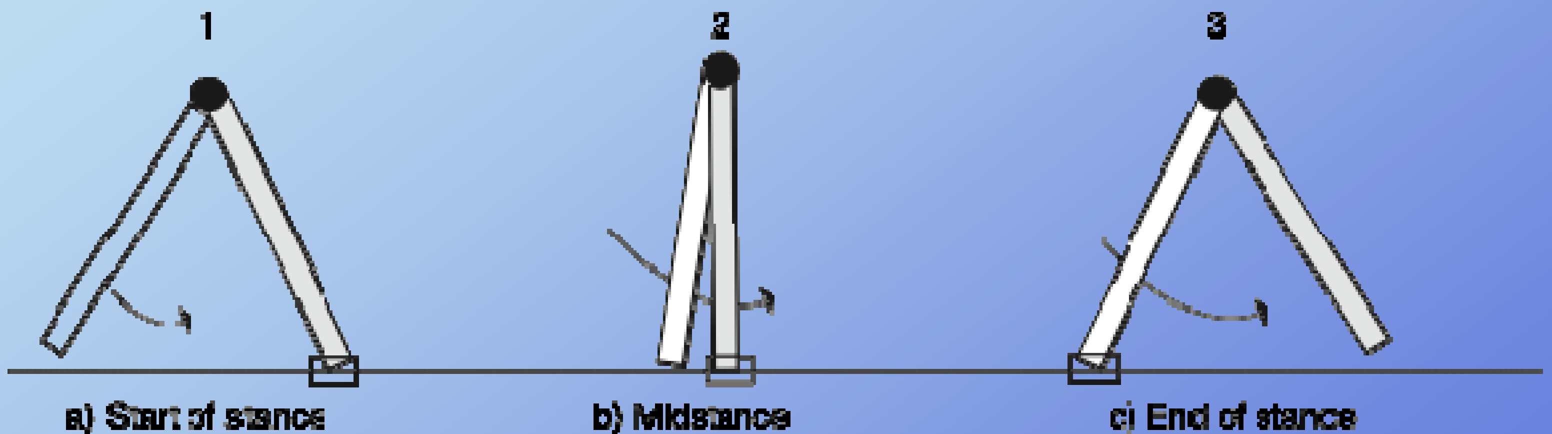
Anatomy of the Walk



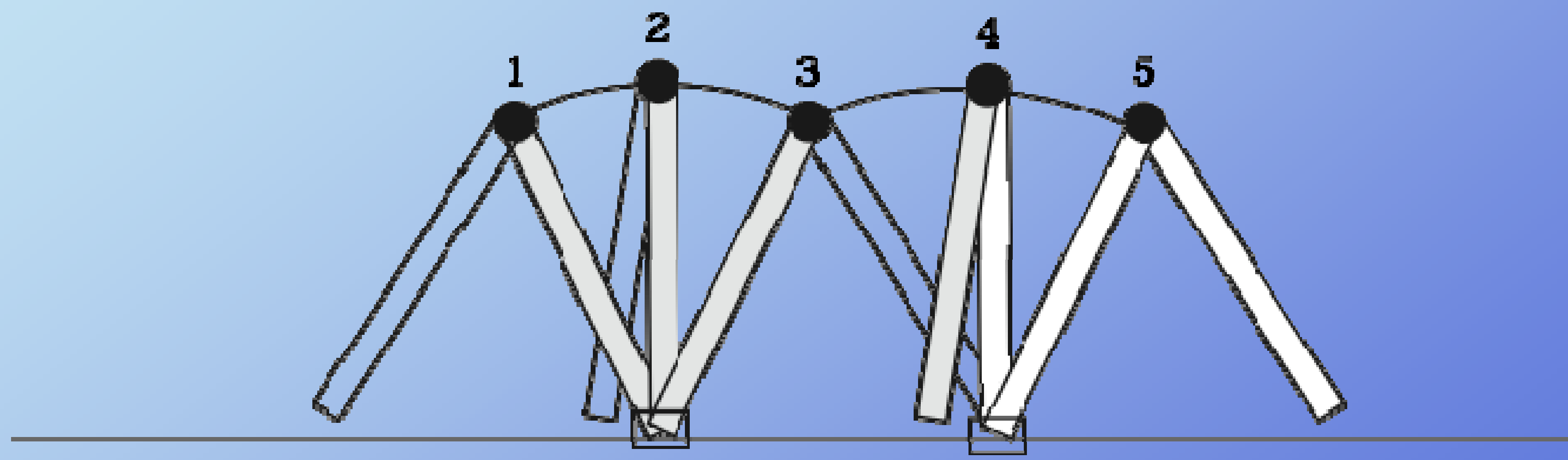
Anatomy of the Run



Pelvic transport

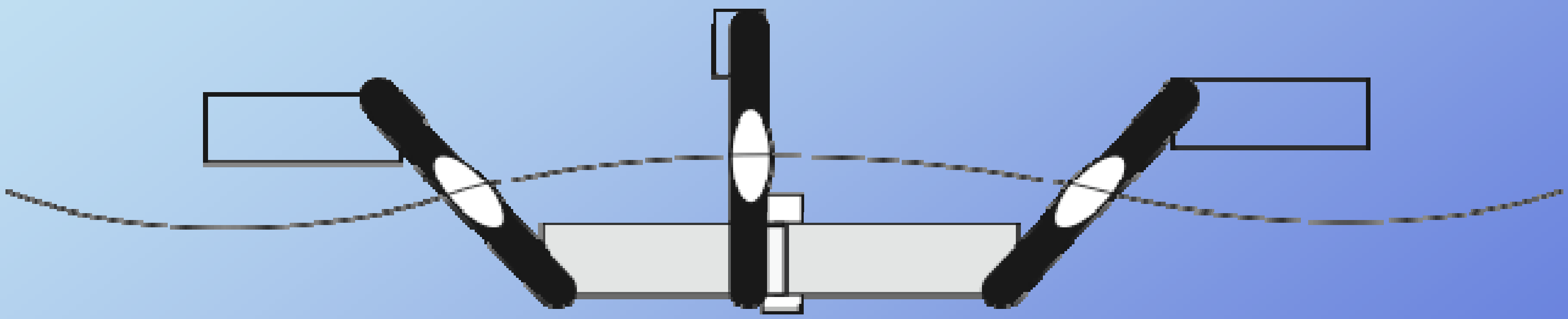


Pelvic rotation over foot

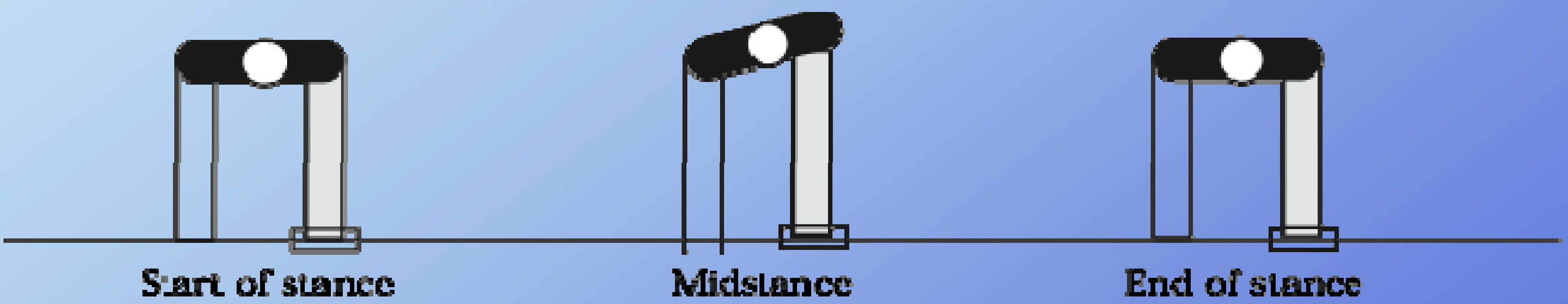


Pelvic rotation around hips

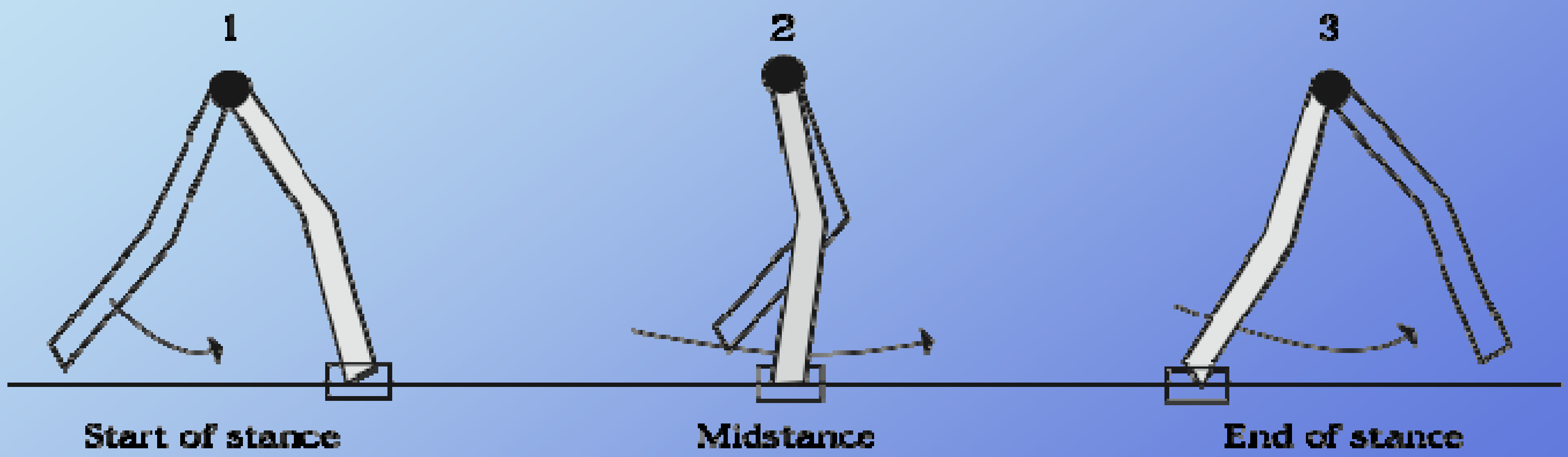
Motion of pelvic



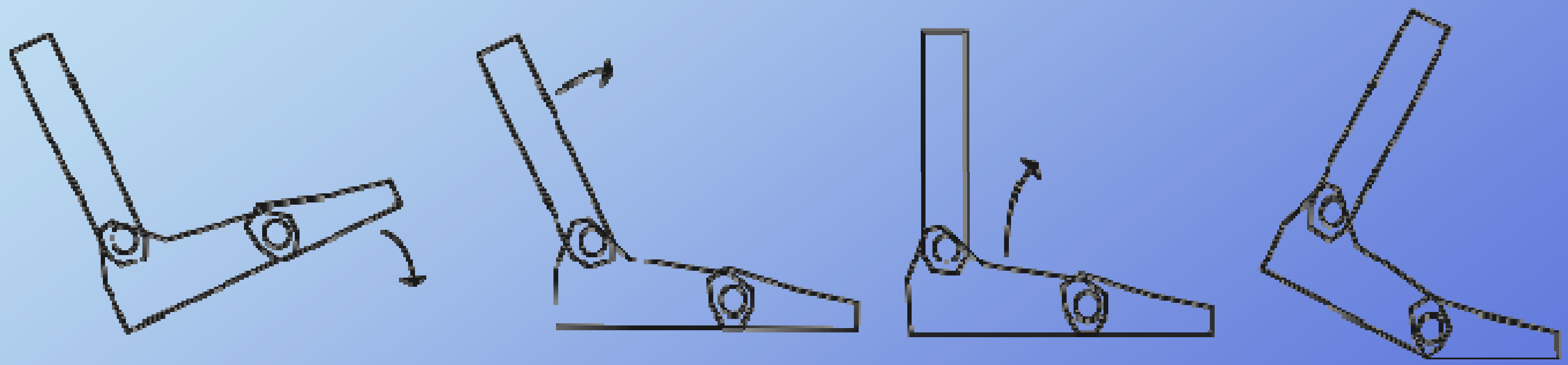
Pelvic tilt



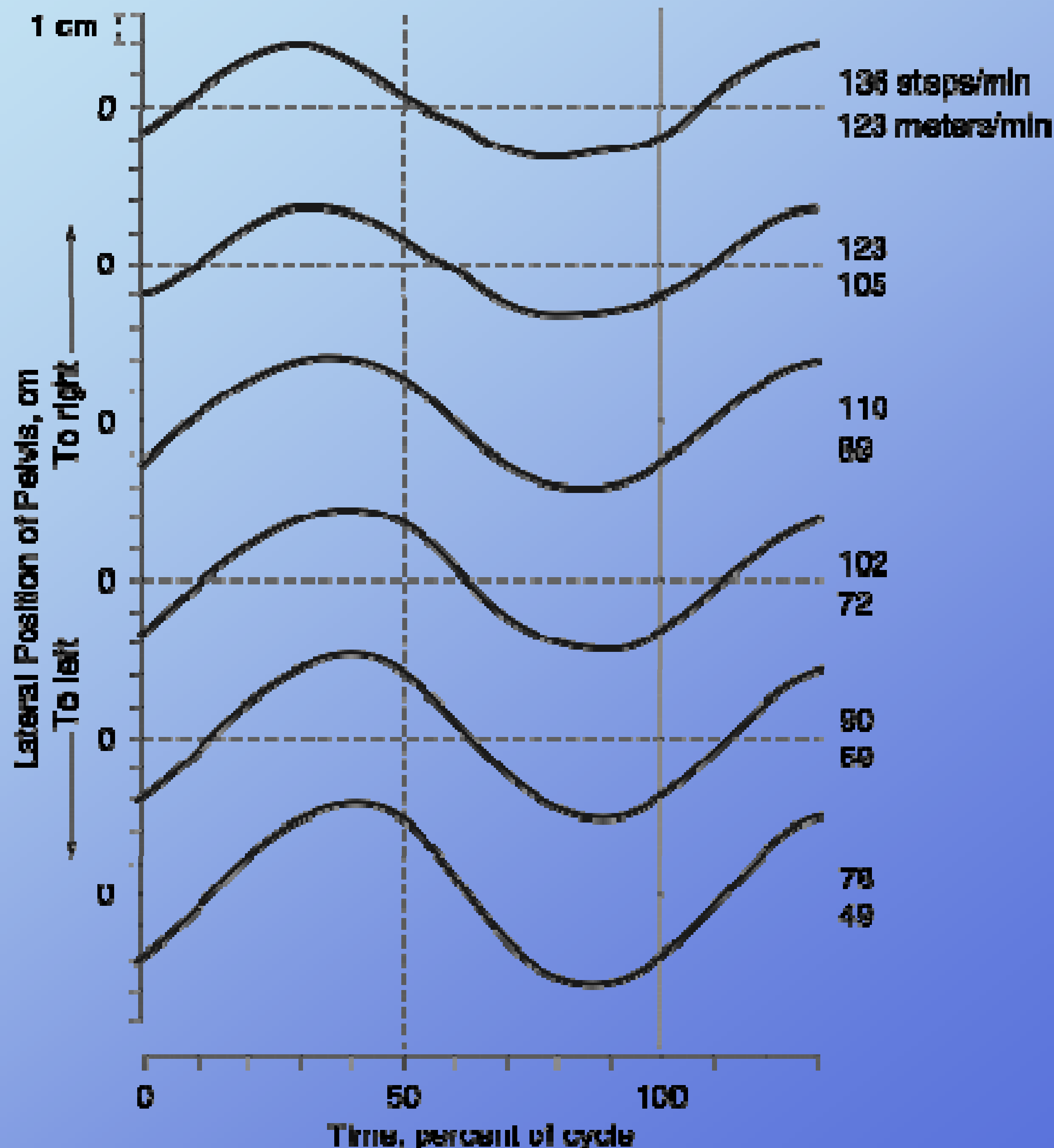
Knee bend to allow tilt



Ankle and Toe bend

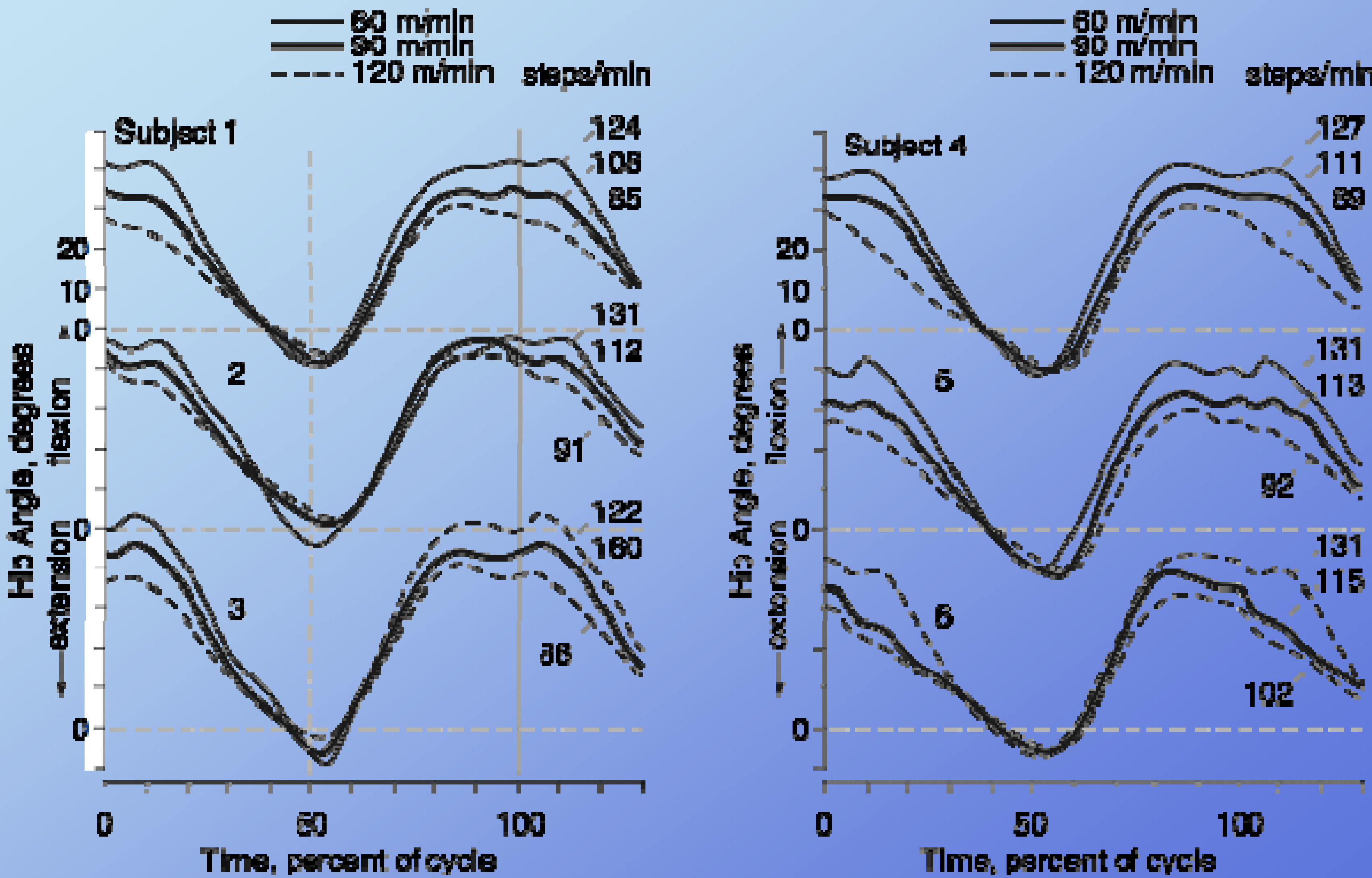


Walk Data



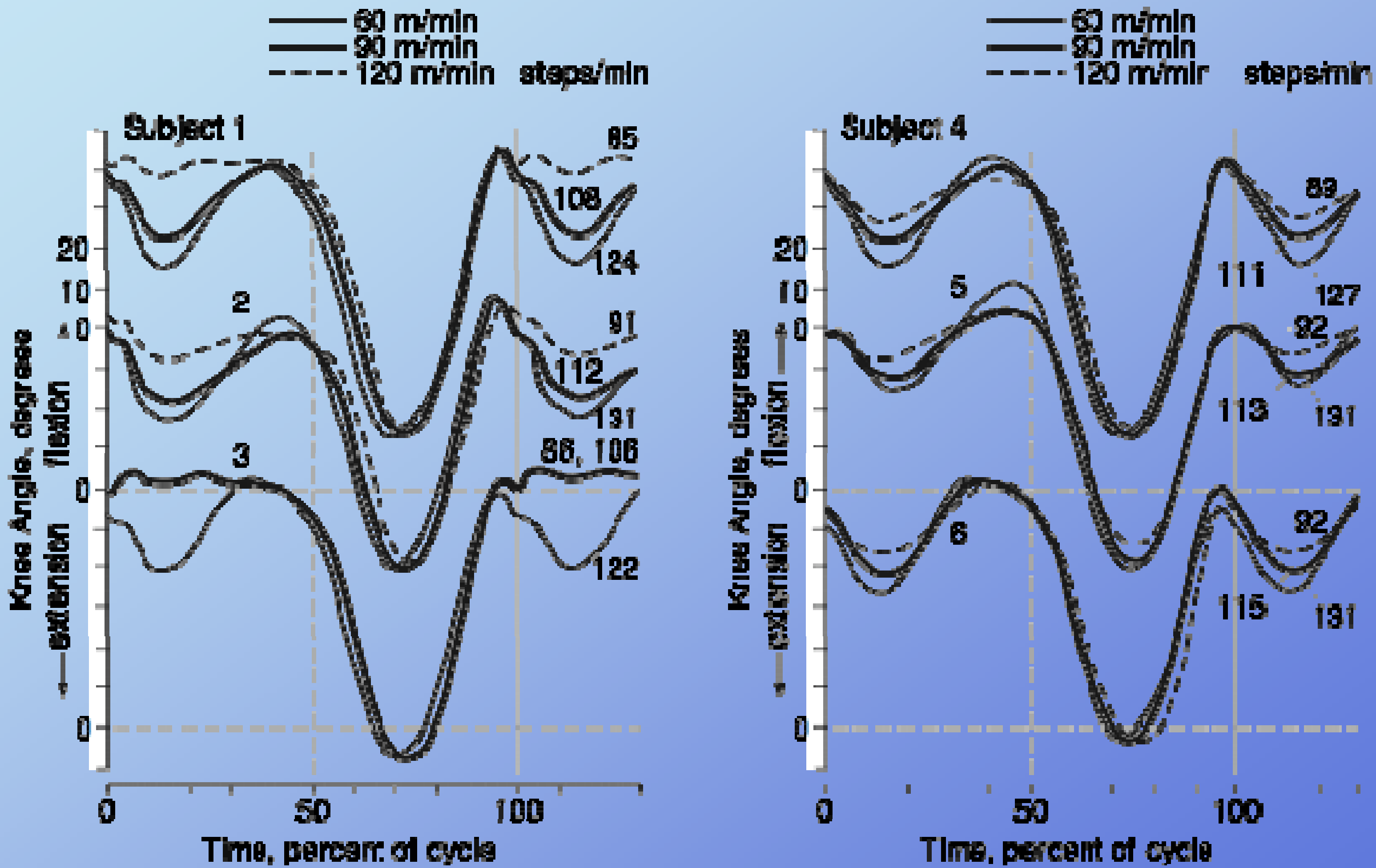
1 cm
0
136 steps/min
123 meters/min
123
105
110
102
72
90
78
49
Lateral Position of Pelvis, cm
To right
To left
0
50
100
Time, percent of cycle

Walk Data

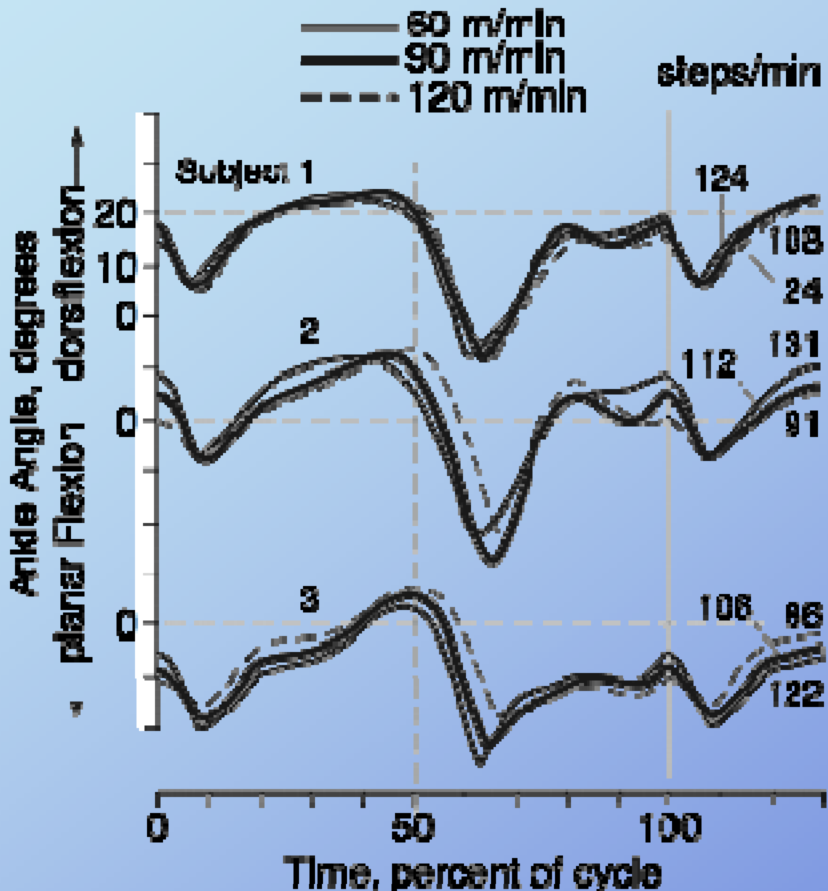


60 m/min
90 m/min
120 m/min
steps/min
Subject 1
124
108
85
131
112
91
122
160
86
2
3
Hip Angle, degrees
extension flexion
20
10
0
0
0
Time, percent of cycle
0
50
100
Subject 4
127
111
89
131
113
92
131
115
102
5
6

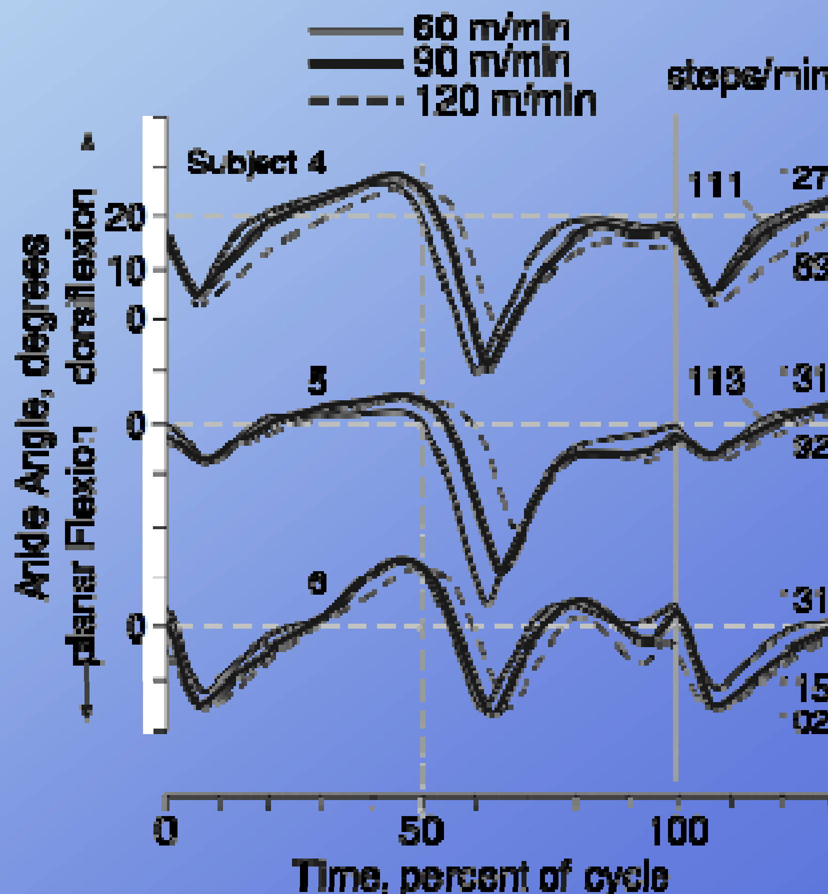
Walk Data


60 m/min
90 m/min
120 m/min
steps/min
Subject 1
Subject 4
Knee Angle, degrees
flexion
extension
Time, percent of cycle
0
50
100
20
10
2
3
5
6
85
108
124
91
112
131
88, 106
122
89
111
127
92
113
131
92
115
131

Walk Data

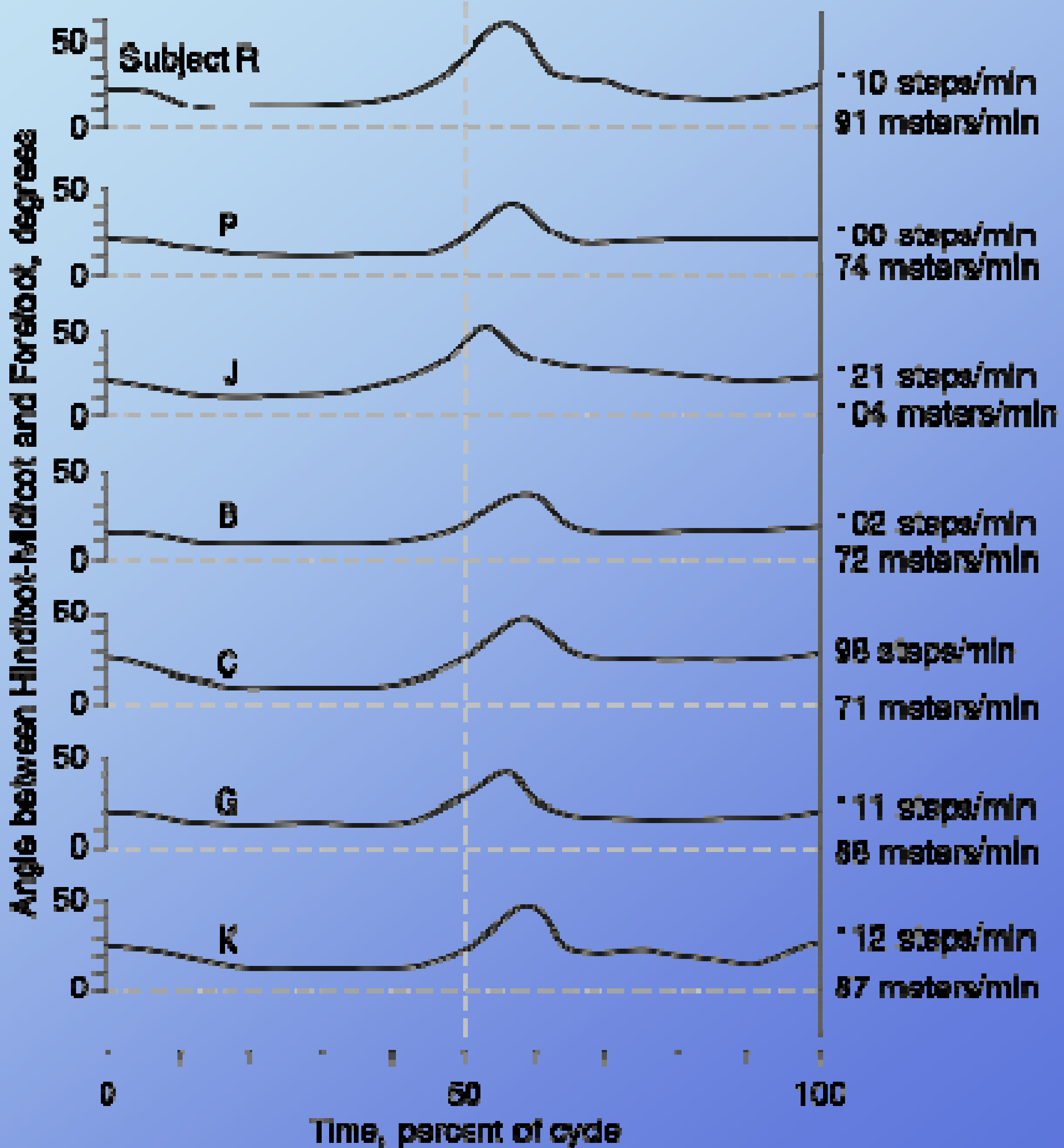


60 m/min
90 m/min
120 m/min
steps/min
Subject 1
2
3
124
108
24
112
131
91
106
86
122
Ankle Angle, degrees
planar Flexion dorsiflexion
20
10
0
50
100
Time, percent of cycle

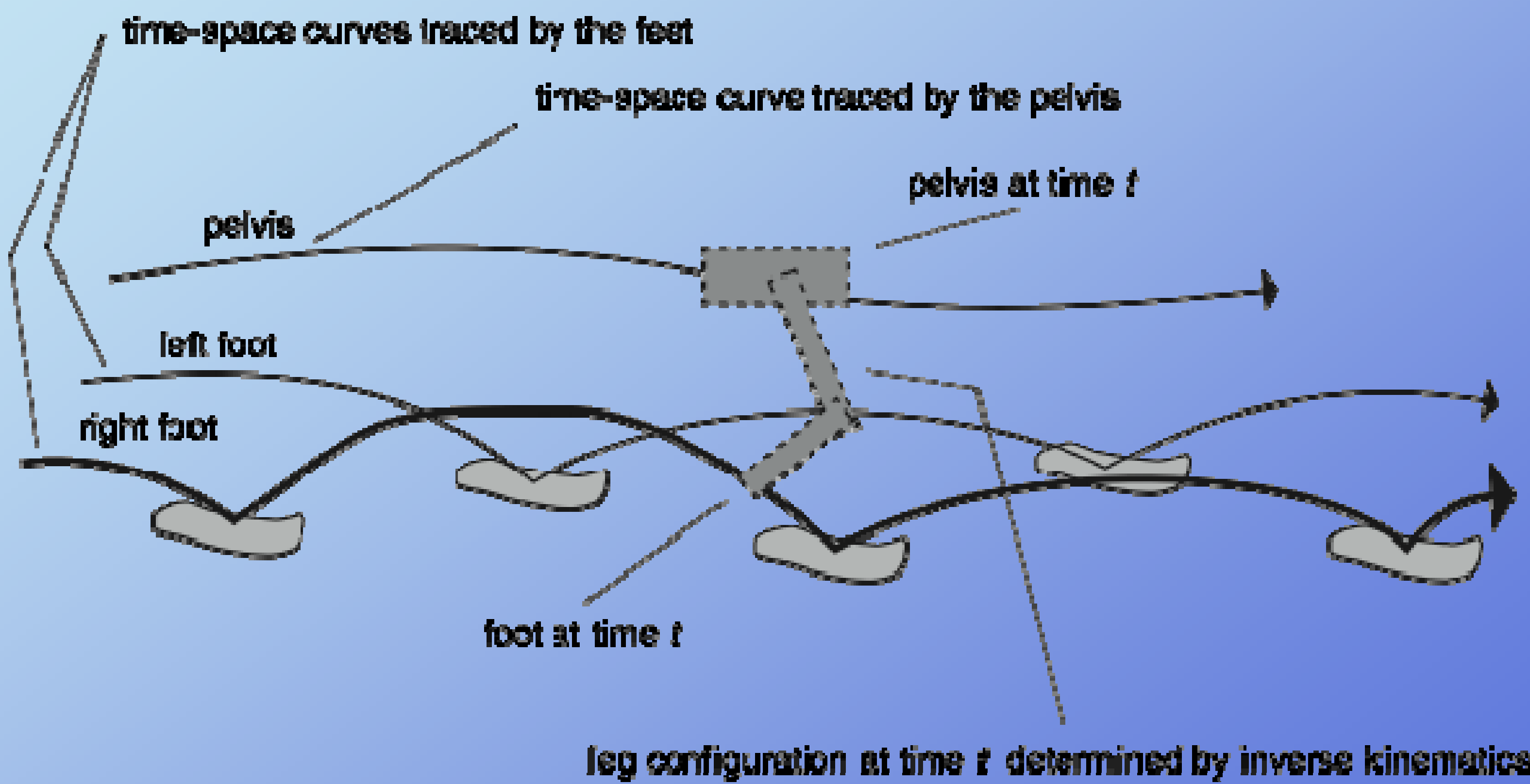


60 m/min
90 m/min
120 m/min
steps/min
Subject 4
5
6
111
113
Ankle Angle, degrees
planar Flexion dorsiflexion
20
10
0
50
100
Time, percent of cycle

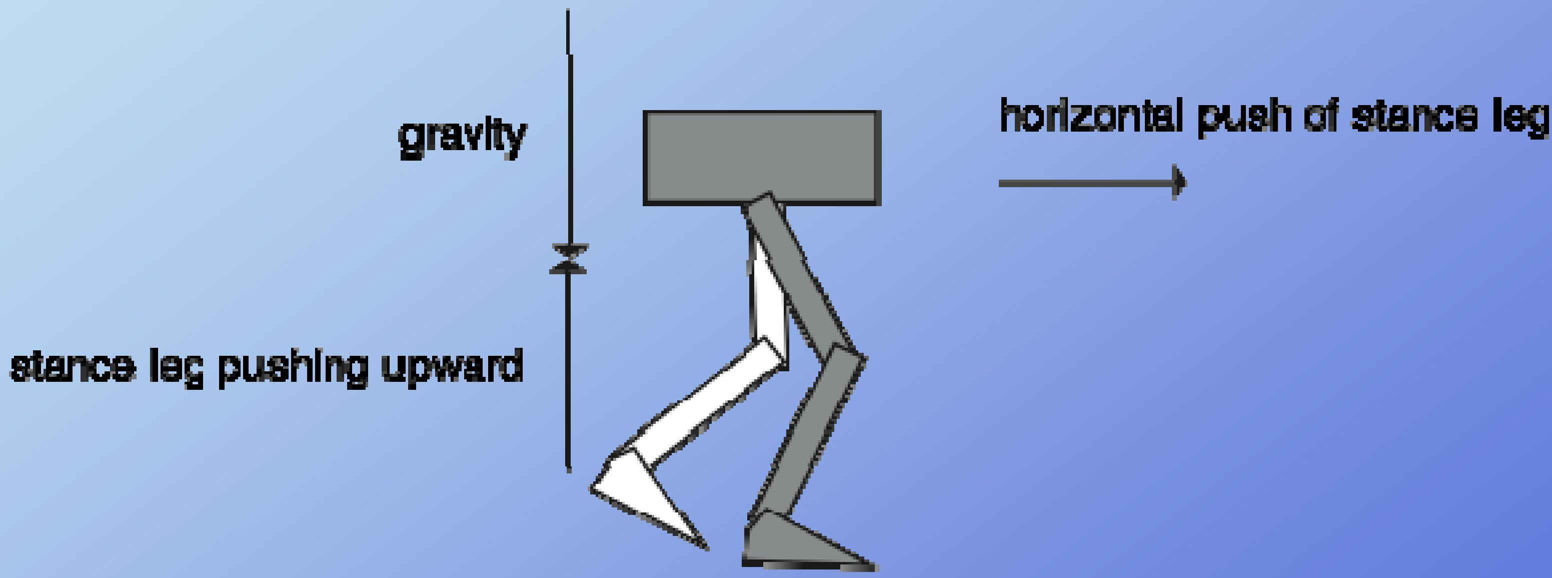
Walk Data


Subject R
P
J
B
C
G
K
110 steps/min
91 meters/min
100 steps/min
74 meters/min
121 steps/min
104 meters/min
102 steps/min
72 meters/min
98 steps/min
71 meters/min
111 steps/min
88 meters/min
112 steps/min
87 meters/min
Angle between Hindfoot-Midfoot and Forefoot, degrees
Time, percent of cycle
0
50
100

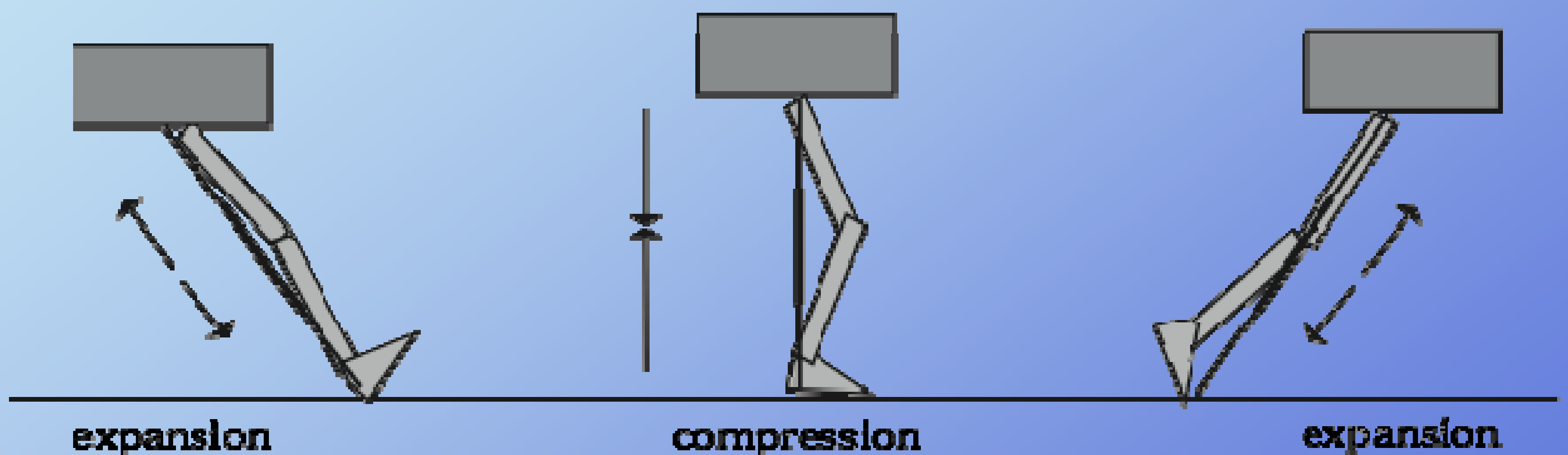
Using Dynamics in the Walk



Using Dynamics in the Walk



Using Dynamics in the Walk



facial animation

Expressions v. speech

facial animation

Parameterized facial attributues

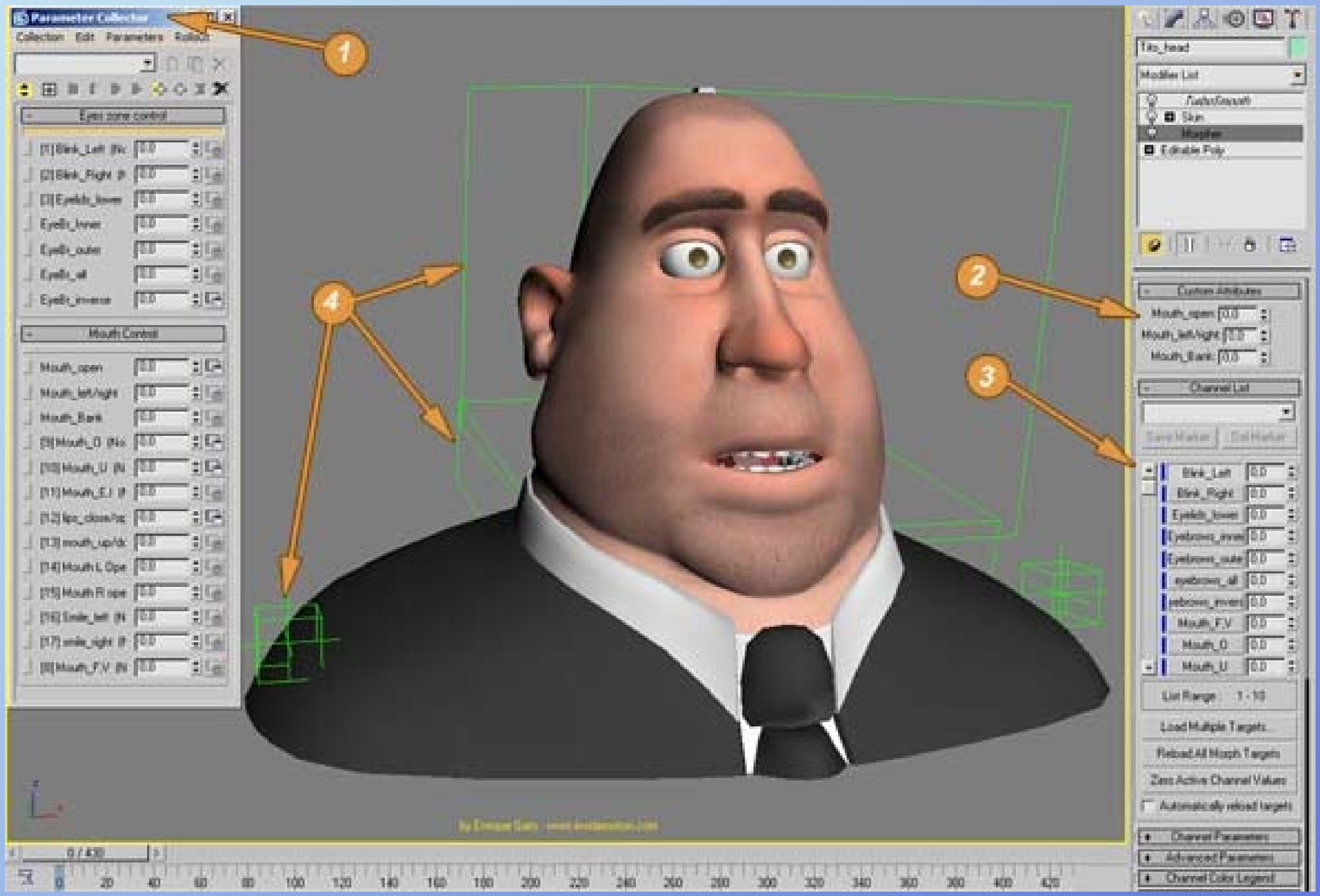
Blend shapes

Muscle models
- surface muscles
- deep muscles

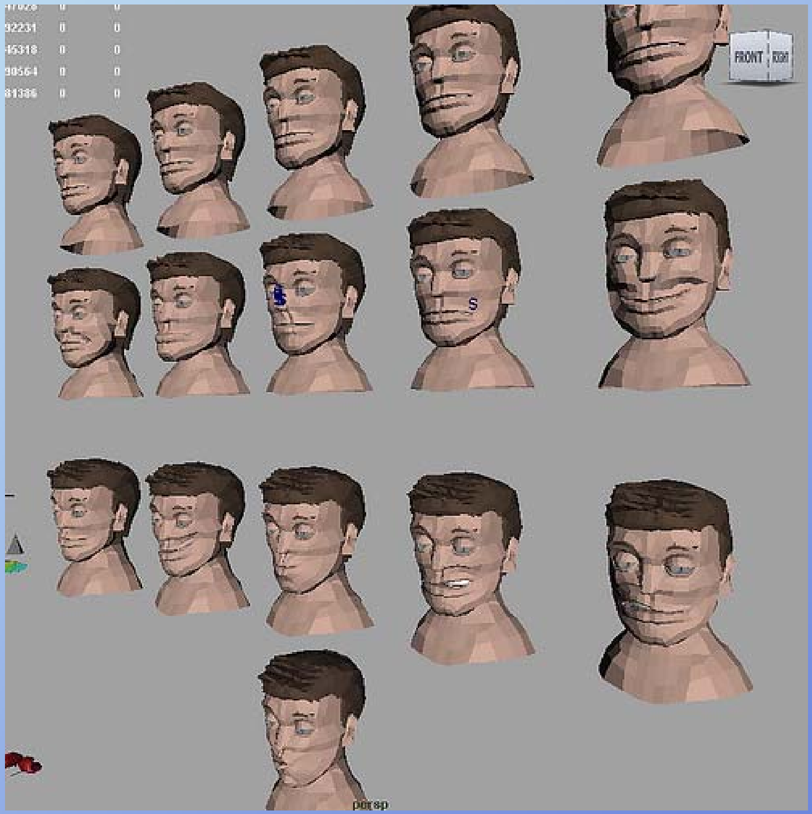
Performance (or data) driven
- instrumented (mocap system)
- video

http://www.youtube.com/watch?v=uQJ7gwG0G5g

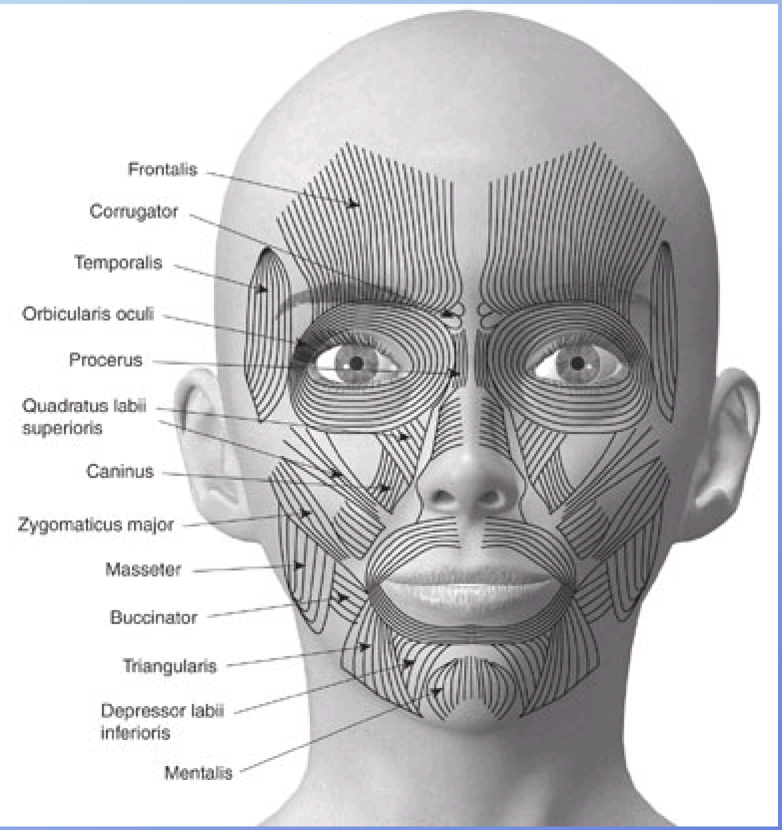
Parameterized Facial features



Facial blend shapes



Facial muscle model



Surface muscle model

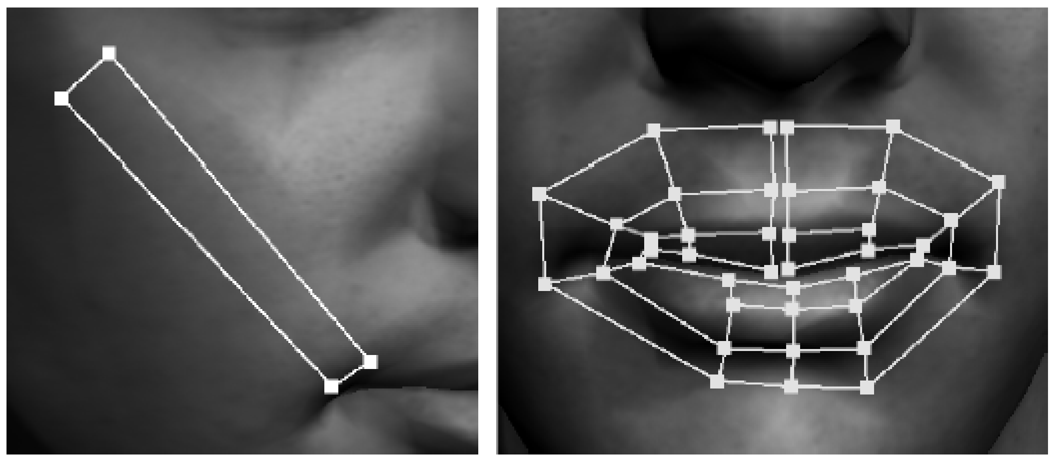


Figure 8: A simple grid (left, zygomatic major*) and a non-uniform complex grid (right,* orbicularis oris*).*

Geometry-based Muscle Modeling for Facial Animation
Kolja K¨ahler J¨org Haber Hans-Peter Seidel

“computer animation” facial

Figure 6. Snapshots taken simultaneously from three video cameras.

“computer animation” facial

Text to speech

Audio to speech

Break down to phonemes

Phonemes to mouth shapes (visemes)

coarticulation

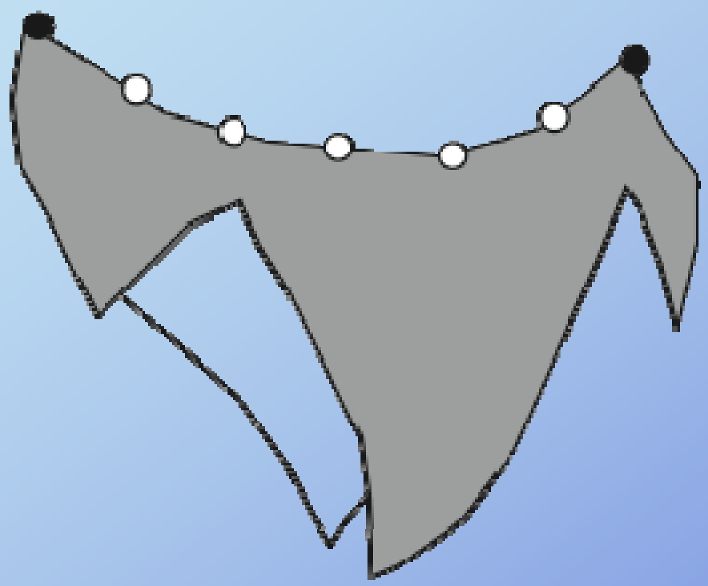
prosody

http://www.youtube.com/watch?v=fxADT-kZNrA

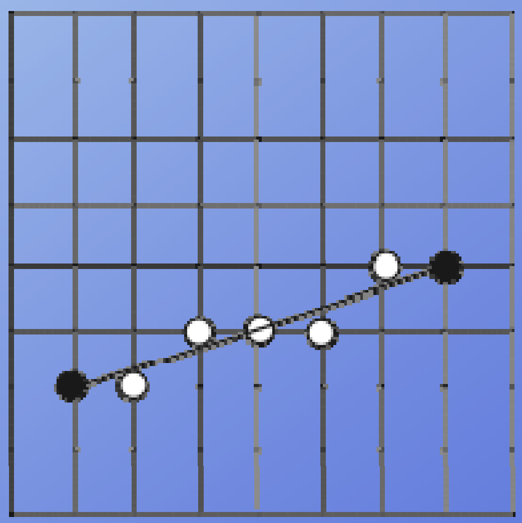
Dressing the Figure

Cloth and clothing
Simple draping
Clothes
Modeling dynamics
Collision detection and response

Dressing the Figure

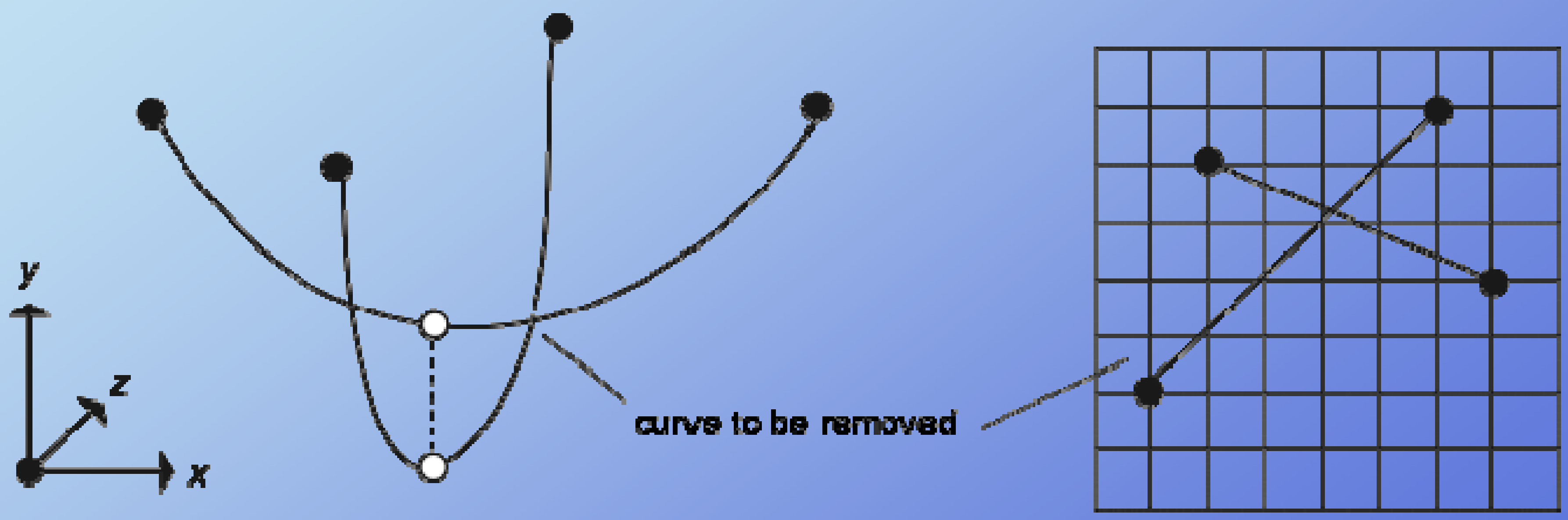


Cloth supported at two constrained points

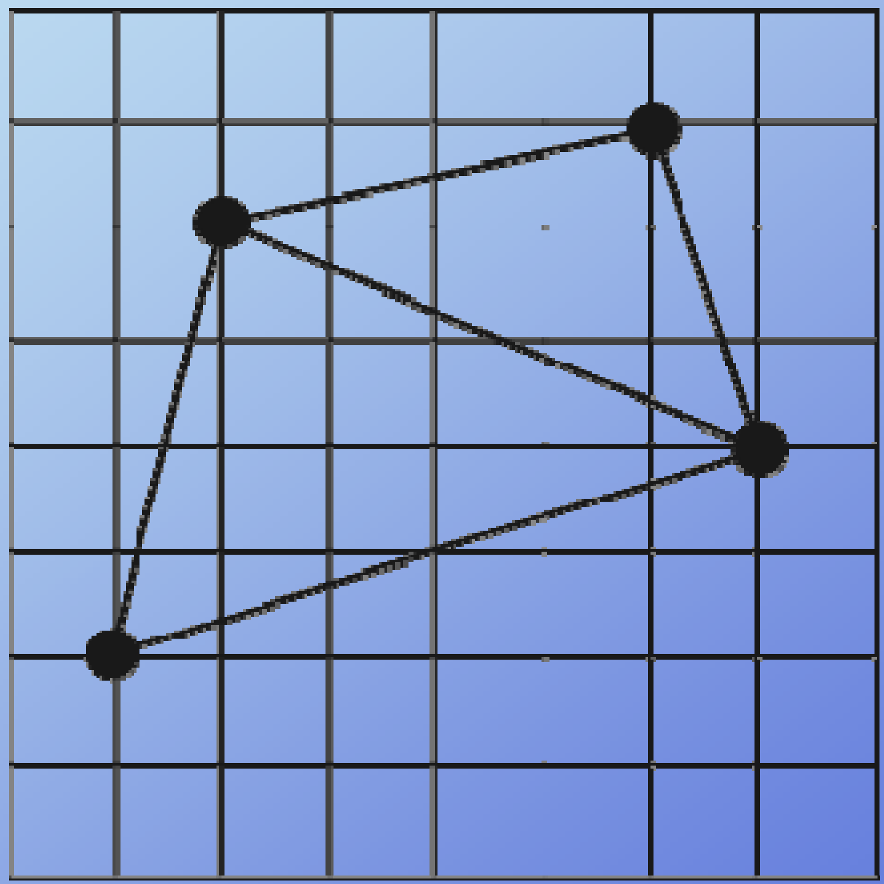


Constrained points in grid space

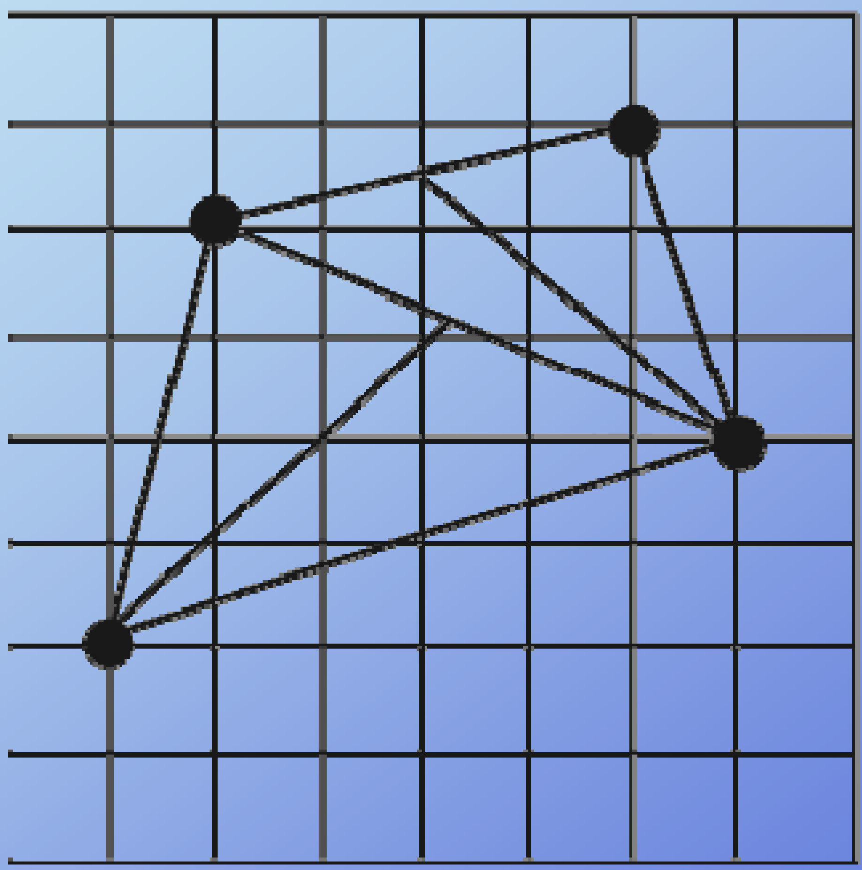
Dressing the Figure



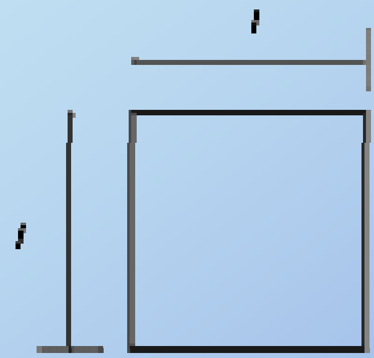
Dressing the Figure



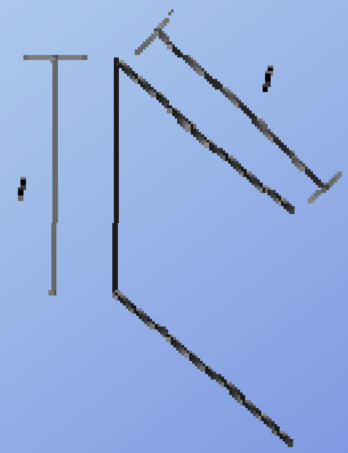
Dressing the Figure



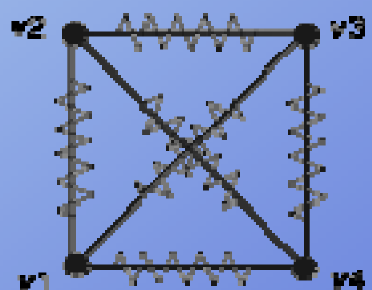
Dressing the Figure



(a) Original quadrilateral of mesh

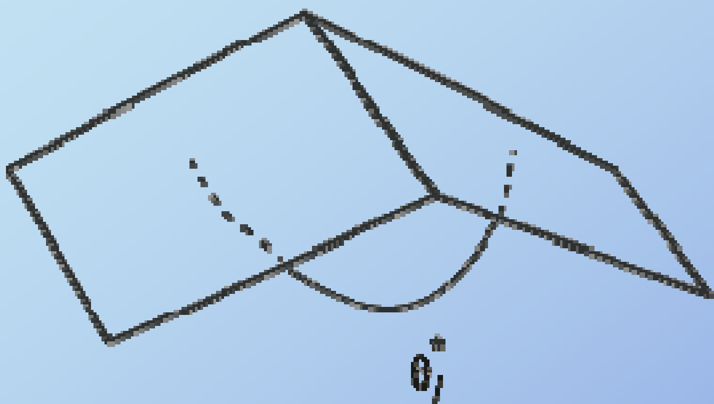


(b) Skew of original quadrilateral without changing the length of edges

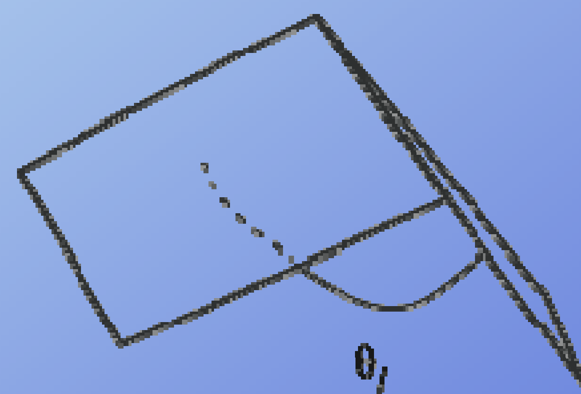


(c) Diagonal springs to control skew

Angular springs

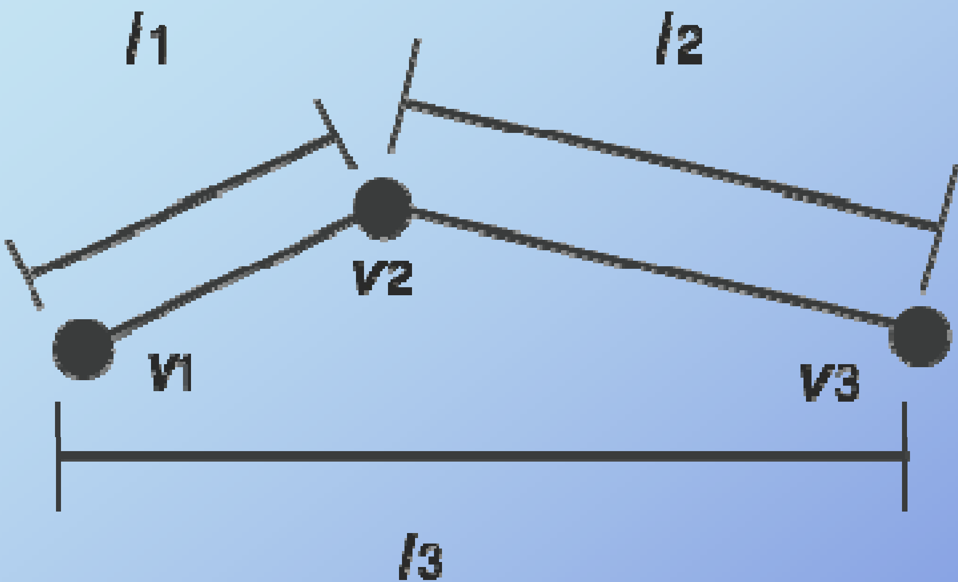


Original dihedral angle



Bending along the edge that changes dihedral angle

Angular springs



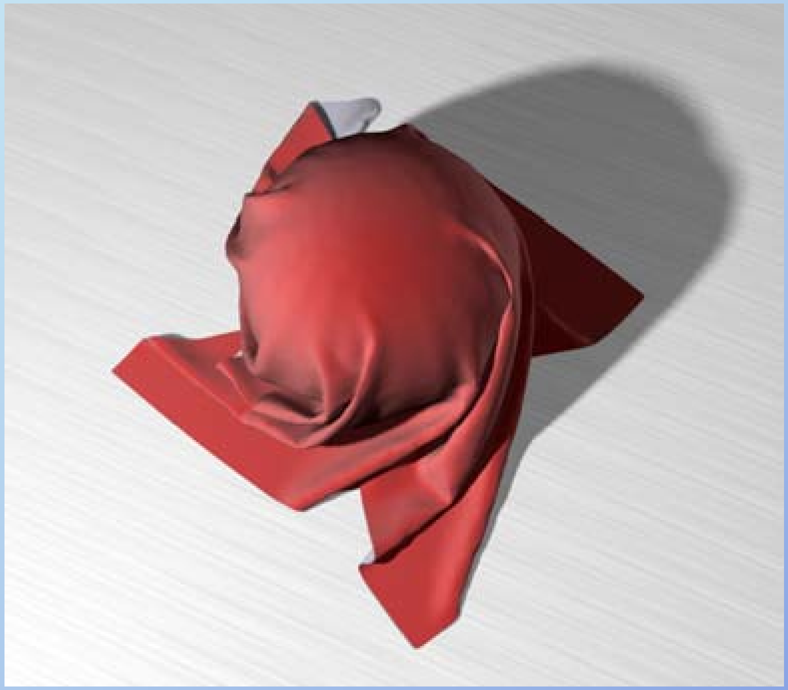
$$l_1 = |v_2 - v_2|$$

$$l_2 = |v_3 - v_2|$$

$$l_3 = |v_3 - v_1|$$

Dressing the Figure

Dressing the Figure



Dressing the Figure

Hair

Complexity
100,000 strands

Collisions

Shadowing

Reflections

Hair types

Populate head with hair

Design hairstyle

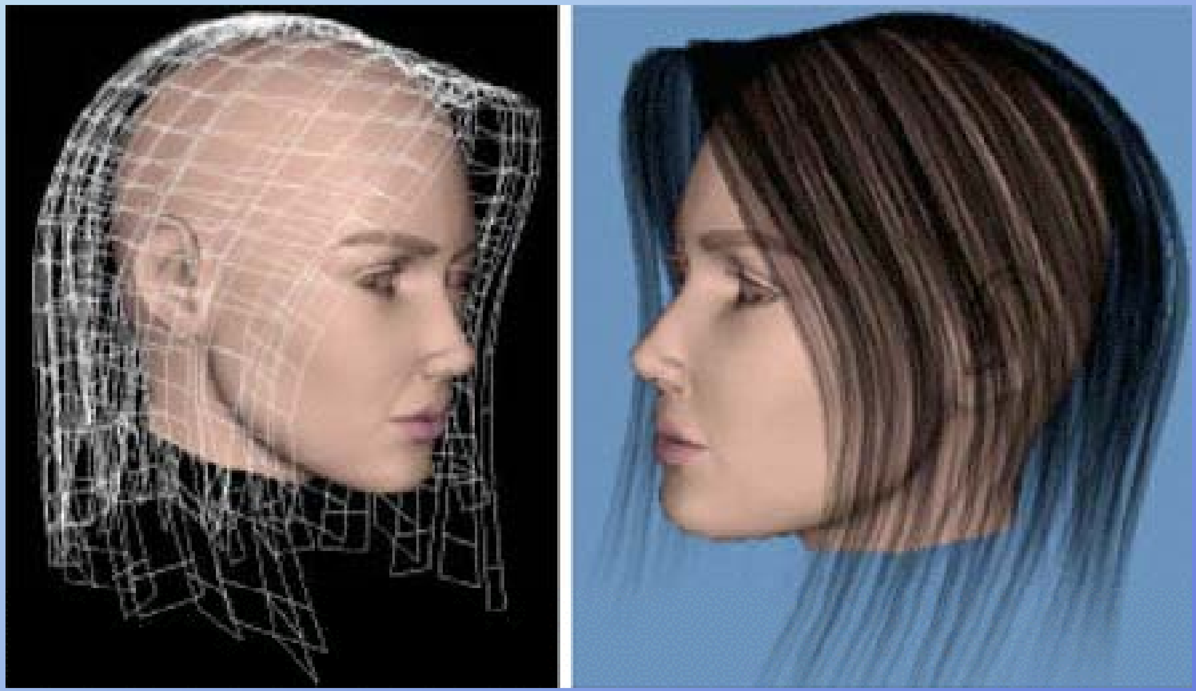
Animate hair

Hair

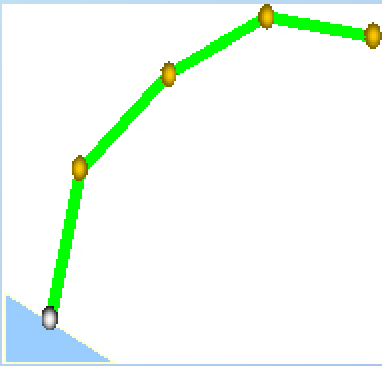
Hair

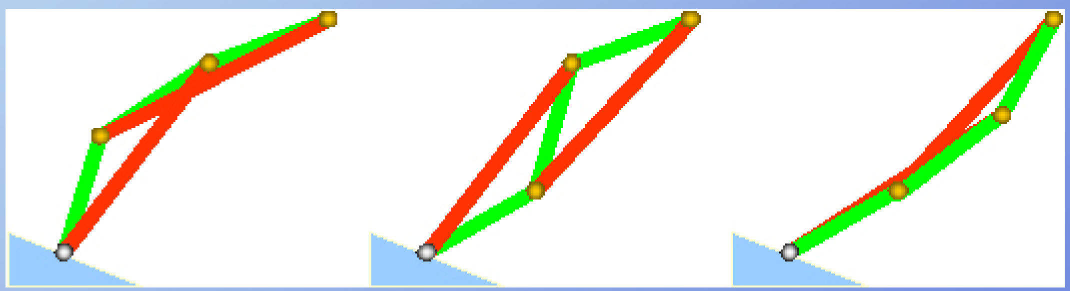
http://run.usc.edu/cs599-s10/hair/c33-hair-sig07.pdf

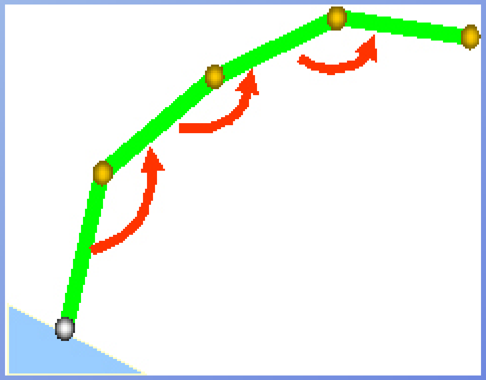
Hair



Hair



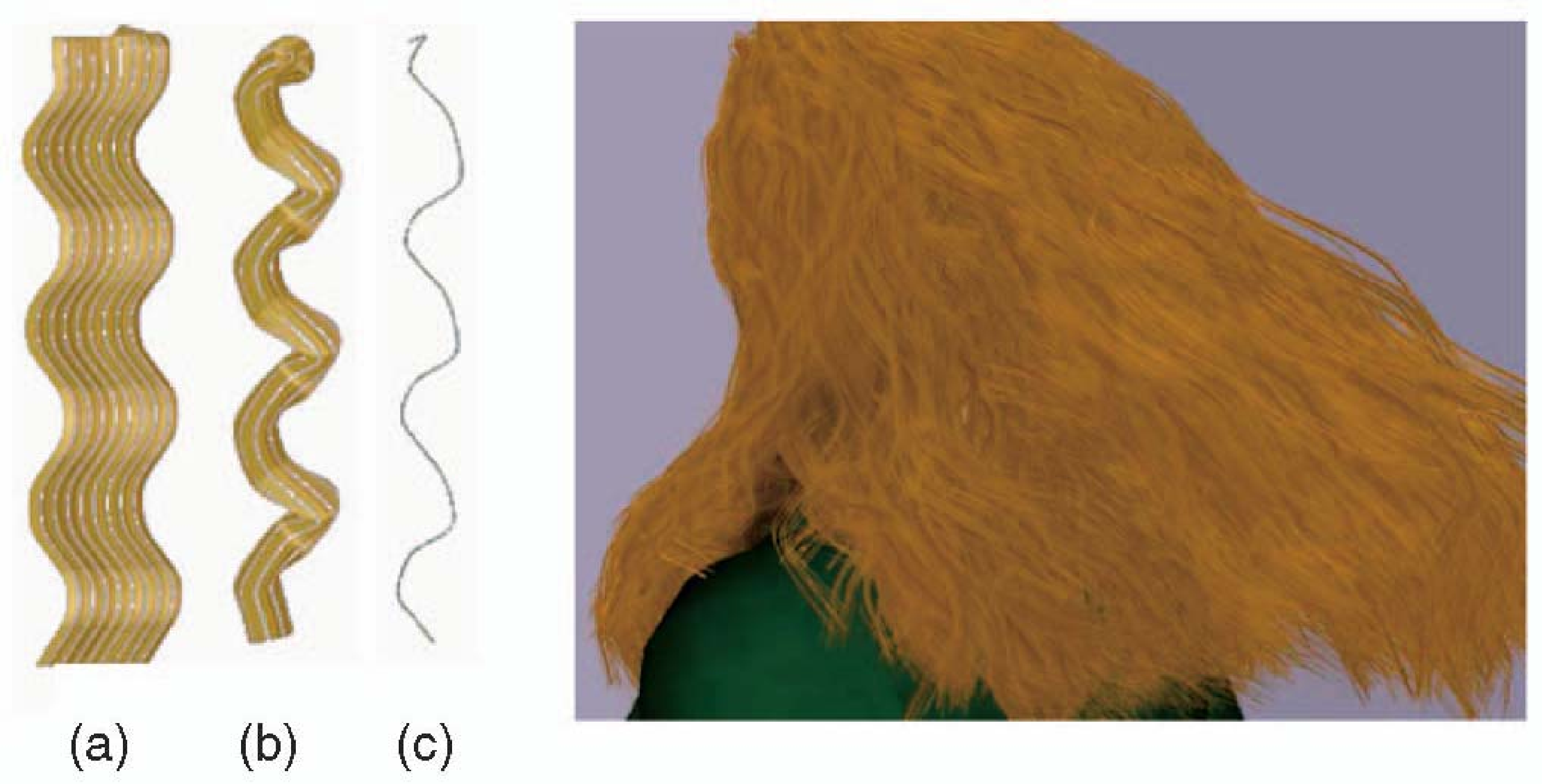




Hair

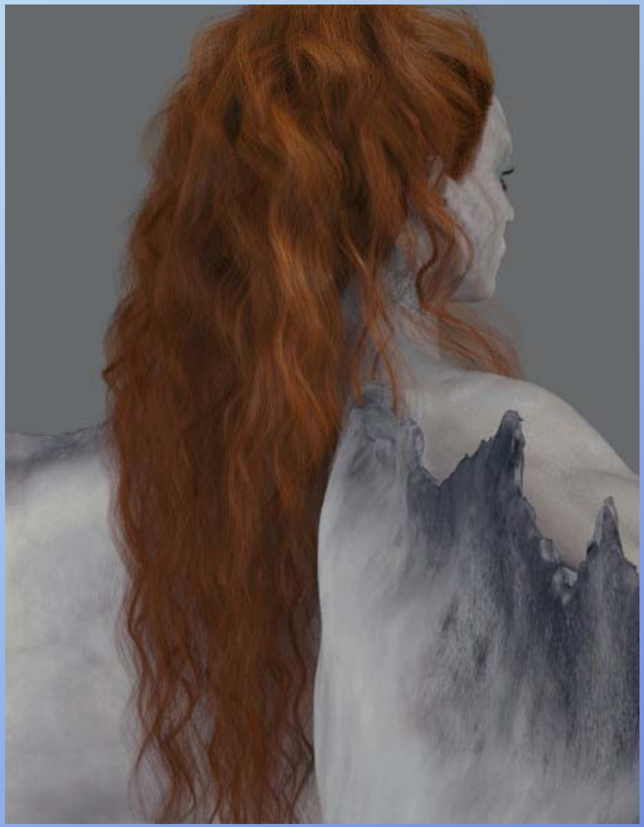
Hair

Hair – Hierarchy



A Survey on Hair Modeling: Styling, Simulation, and Rendering
Kelly Ward, Florence Bertails, Tae-Yong Kim, Stephen R. Marschner, Marie-Paule Cani, and Ming C. Lin,

Hair



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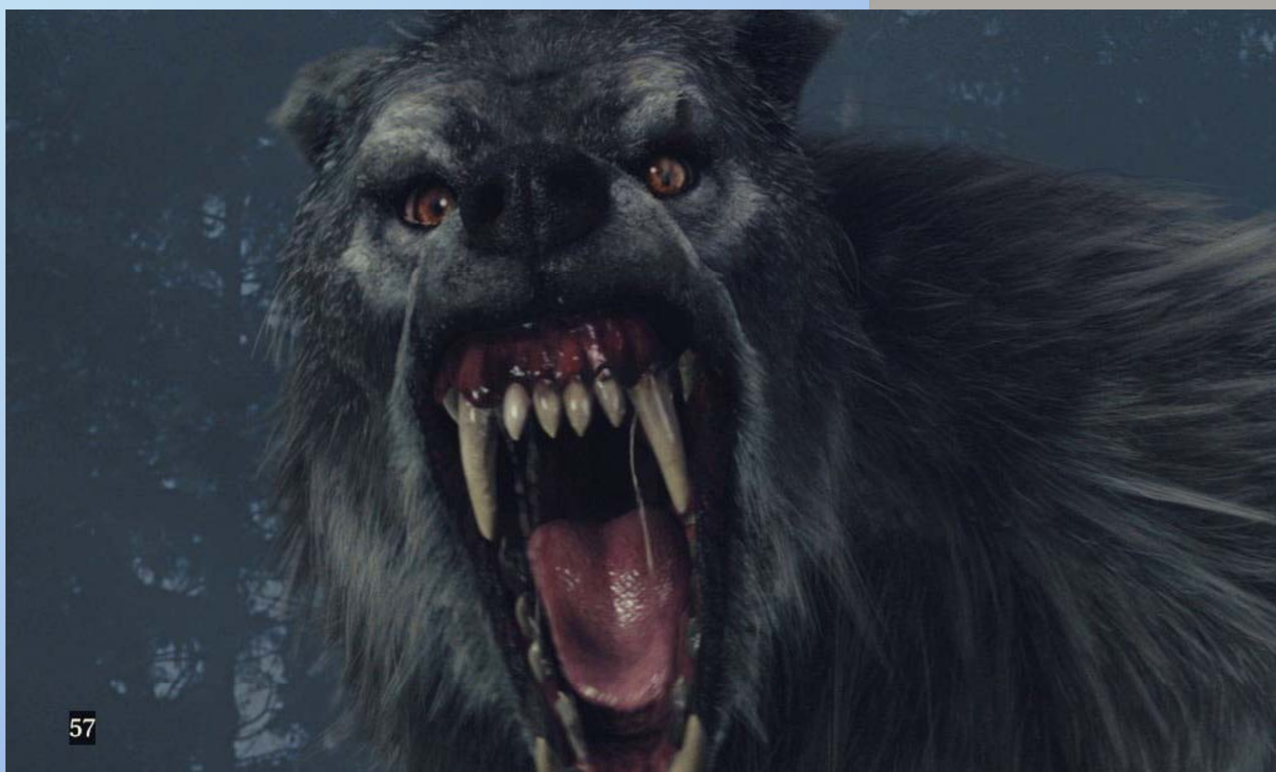

Hair