PICTURE THIS: HOT MEASUREMENT AND MODELING METHODS IN MOVEMENT DISORDERS RESEARCH

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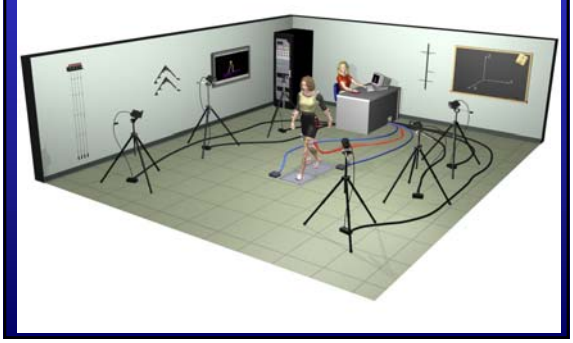
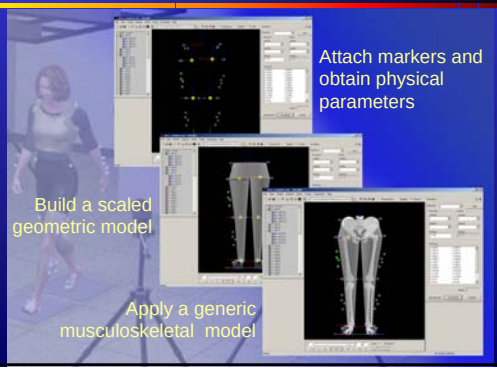
Movement Analysis Laboratory



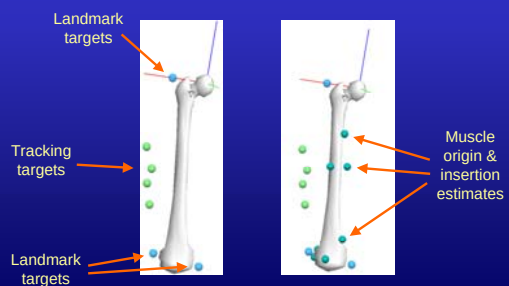
Overview of the basic process



Enhanced Movement Analysis (6 DOF Joint Models)

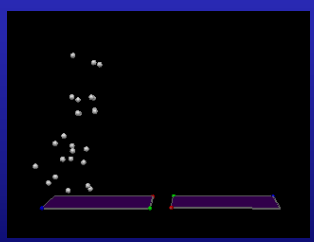
Visual inspection of data/errors

Enhanced Movement Analysis (Muscle kinematics)



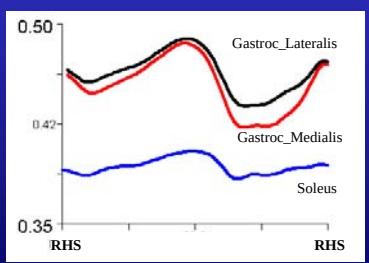
Enhanced Movement Analysis (Muscle lines of action)

Picture this: (Modeling Methods)



Repeat animation of walking depicting various models

Muscle Kinematics



Muscle Kinematics

Muscle lines of action

Muscle length changes

Muscle contraction velocities

Are precursors to:

Individual muscle motion control “sensitivities”

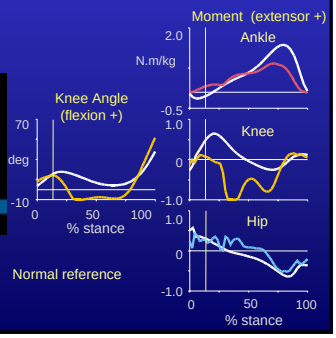
Individual muscle forces and their effects?

Picture this: (Motion control sensitivities)

Patient case

- 54 y/o Male
- Amyotropic lateral sclerosis
- Impairments: lower extremity weakness
  Left (2/5), right (4/5)

Patient case - Motion and Moments



Normal reference

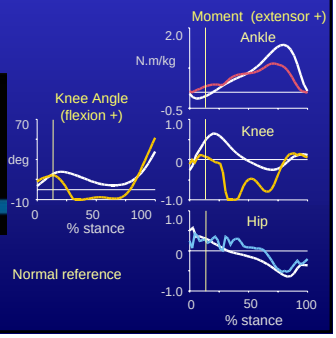
What causes the left knee to extend so rapidly?

Picture this:
The ability to inspect all possible causes

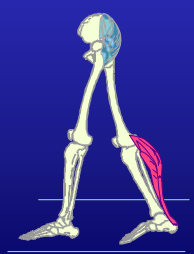
Induced Acceleration Analysis (IAA)

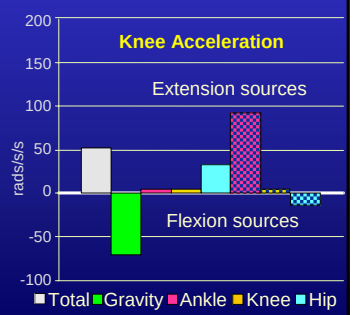
1. Perform a movement analysis that includes inverse dynamics analysis.
2. Insert one sample (instant) of the subject's measured position and force data into a coupled dynamics model.
3. Numerically explore the set of coupled dynamics equations to determine the muscle moment/joint movement (acceleration) relationships.
4. Return to step 2 until last instant.

Patient case - Motion and Moments



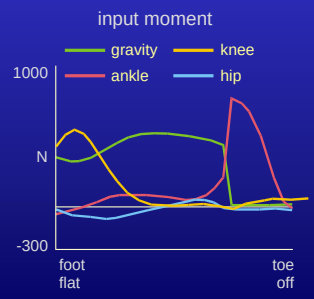
IAA – Left Knee Control





Motion simulation using right ankle moment

COM Control – Vertical Force / Acceleration



Ankle plantar flexors:

- provide vertical support

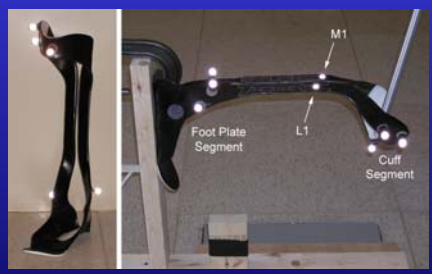
Picture this: Contribution of assistive technologies

Advanced Prosthetics and Orthotics Inc, Encinitas, CA

Determining the AFO's contribution

Understanding the contribution of a Dynamic Ankle Foot Orthosis (DAFO) and the patient's adaptation to the DAFO during the stance phase of gait are important steps towards predicting and obtaining desired outcomes.

Dynamic AFO Model



STIFFNESS MODELS

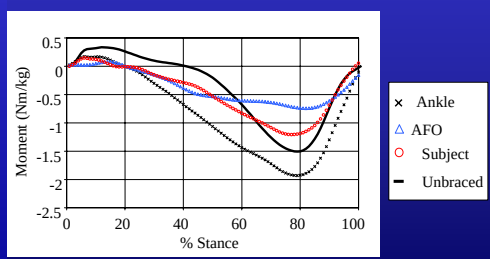
	Subject 1	Subject 2
KDF (Nm/deg)	-4.0	-3.0
KPF (Nm/deg)	-6.5	-4.5

Dynamic AFO - Subjects

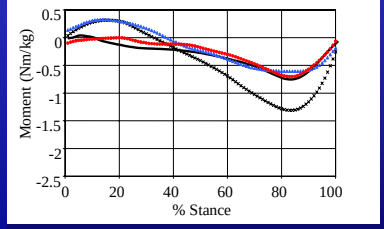
	Subject 1	Subject 2
Diagnosis	Post Polio Syndrome	Post Polio Syndrome
Age/Gender	66/M	58/F
Ht/Wt (m/kg)	1.85/81.8	1.6/52.3
Prescription	Bilateral Dynamic AFO	Dynamic AFO - Left 5/8" Lift - Right

	Subject 1	Subject 2
Speed Unbraced (Stat/s)	0.65	0.55
Speed AFO (Stat/s)	Same	Faster
Stride Length Unbraced (Stat)	0.84	0.68
Stride Length AFO (Stat)	Same	Longer

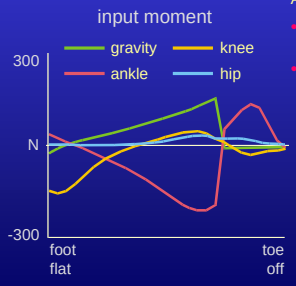
Subject 1



Subject 2

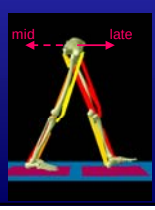


COM Control – A/P Force / Acceleration



Ankle plantar flexors:

- in mid stance – slow forward motion
- in late stance – provide forward propulsion



Summary

6 Degree of Freedom Models (visualization)

Muscle Kinematics (LOA)

Induced Acceleration Analysis (IAA)

- Limb (joint) control
- Body support & propulsion

Contribution of assistive technology

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