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Instructions for Workshop Attendees

Welcome to our workshop! We are looking forward to hosting this workshop to dive deeply into the world of foot-ankle biomechanics. This workshop will include a mix of theoretical concepts regarding distal power calculation (also called unified deformable segment analysis in the literature) and a hands-on session to apply the computation to existing data.

Thank you to those of you who completed a pre-conference survey back in June! The feedback was immensely helpful in preparing for this workshop.

Based on the survey results, we will offer our hands-on session using Matlab. Over 75% of the responders identified Matlab as their preferred language for biomechanics analysis. However, even if you have no experience in Matlab, we hope you'll be able to generate figures from our sample code/data and learn the theoretical aspects of the workshop. We encourage all attendees to participate in our hands-on session to apply the distal power analysis, using either our sample data or data from your own lab.

Please note that the distal power calculation is already a built-in command in Visual3D software, so we will not cover the computation in Visual3D during this workshop.

<u>If you would like to apply the distal power analysis on data from your own lab</u>:

Before the workshop, you will need to export your data to a .Mat file that include the following time-series data:

- Ground reaction forces (X, Y, Z axes) – in Newtons
- Center of pressure (X, Y, Z axes) – in Meters
- Free moment (X, Y, Z axes) – in Newton*Meters
- *Segment Center-of-Mass position (X, Y, Z axes) – in Meters
- *Segment Center-of-Mass velocity (X, Y, Z axes) – in Meters/sec
- *Segment Angular Velocity (X, Y, Z axes) – in Radians/sec

  *Segment could be any segment in the lower extremity (most commonly shank or foot segments). The distal power analysis quantifies the summed effect of all structures distal to the chosen segment. For example, distal power applied to the shank segment would quantify the summed effect of the ankle joint and all foot structures.

- *Treadmill velocity – in Meters/sec

  *this is not required for overground data. In the sample files provided in the workshop, our sample Matlab code will calculate treadmill velocity from the foot segment's center-of-mass velocity.

- Ankle joint power (scalar) – in Watts

  *this is optional. This is only used for comparison, and not required to do distal power computation.

Additional suggestions and guidelines about the time-series data:

- All of the time-series data above should be in the laboratory coordinate system.
- Our sample Matlab code takes in un-normalized time-series data (i.e., not normalized to stride cycle or stance phase).
- Our sample .Mat file has the same sampling rates for the kinetics (ground reaction force, center of pressure, free moment) and kinematics (position, velocity, etc) data – kinetics were downsampled to match the kinematics sampling rate.

Our sample code currently relies on .Mat file's variables with a certain naming convention.

"nonamputee_hindfoot&shank.mat"

Workspace

Name ▲	Value
LANKPow3DOF	943x1 double
LCOP	943x3 double
LFreeMom	943x3 double
LGRF	943x3 double
LHF_AngVel	943x3 double
LHF_CGPos	943x3 double
LHF_CGVel	943x3 double
LSHK_AngVel	943x3 double
LSHK_CGPos	943x3 double
LSHK_CGVel	943x3 double
time	943x1 double

"amputee_R&Lshank.mat"

Workspace

Name ▲	Value
LANKPow3DOF	1056x1 double
LCOP	1056x3 double
LFreeMom	1056x3 double
LFT_CGVel	1056x3 double
LGRF	1056x3 double
LSHK_AngVel	1056x3 double
LSHK_CGPos	1056x3 double
LSHK_CGVel	1056x3 double
RANKPow3DOF	1056x1 double
RCOP	1056x3 double
RFreeMom	1056x3 double
RFT_CGVel	1056x3 double
RGRF	1056x3 double
RSHK_AngVel	1056x3 double
RSHK_CGPos	1056x3 double
RSHK_CGVel	1056x3 double
time	1056x1 double

- 'LHF' = left hindfoot segment
- 'LSHK' = left shank segment
- COP = center-of-pressure
- FreeMom = free moment
- GRF = ground reaction force
- AngVel = segment angular velocity
- CGPos = segment center-of-mass position
- CGVel = segment center-of-mass velocity
- 'LFT_CGVel' is only for the treadmill velocity computation.
- 'ANKPow3DOF' is only used for comparison, and not needed for distal power computation.