Force Overview

This page provides a useful jumping off point to learn about how |external forces are represented within Visual3D and how these forces are included in the inverse dynamics calculations.

If you are searching for the computation of forces and moments, see the section on Inverse Dynamics.

Force Platforms

The traditional method for measuring external force for inverse dynamics of gait analysis is a force platform. In recent years, force sensors have been incorporated into a variety of structures, such as Steps and Treadmills. Visual3D treats these forces as force structures, which are really structures attached to force platforms or to contiguous force platforms spaced in a grid.

There are additional considerations for modelling instrumented treadmills and dynamic force platforms with Visual3D. This is a result of the C3D file format being set up to handle static force platforms only, but both of these sensors can be modelled.

A PDF slide package for a lecture on force platforms is available for download.

Force Assignment

In order to include a force in the inverse dynamics calculations it is necessary to assign the force to a segment. In many cases, force platforms or force structures, Visual3D attempts to assign the forces automatically. Forces can also be defined by the user, and assigned to a segment. Whether forces are assigned automatically or manually, it is important to verify that these assignments are correct. Incorrect force assignments will inevitably propagate into your subsequent analysis leading to, for example, bad gait events.

As of Visual3D version 4, a colour scheme is used for animating forces to indicate whether or not the force is assigned:

1. A red arrow is an unassigned force from a Force Platform.
2. A blue arrow is a Force Assignment (not necessarily related to a force platform) to a segment.
3. A yellow arrow is a force on a Force Structures (e.g. a step).

Model-based Items

There are two model-based items of interest for assigned forces:

1. GRF_DATA
2. COP Path

Using Processed Forces for Segment to Force Assignments

Visual3D includes options to use processed analog, target, and force signals for subsequent analysis. In most situations, you want “Use Processed Analogs” and “Use Processed Targets” set to TRUE and Use “Processed Forces” set to FALSE. A discussion about why we recommend filtering analog signals over force signals can be found on this wiki as well as in this fascinating conversation on biomch-l.

CalTester Mode

Visual3D's CalTester Mode allows users to properly calibrate their lab in terms of the positions of the force platform(s) and cameras in the laboratory coordinate system. Any errors in the parameter settings or calibration measurements will lead to incorrect values of kinetic calculations that rely on the force data. This is important to understand as accurate and reliable kinematics and kinetics data are essential to the appropriate analysis of movement data.

Using a computational method based on static equilibrium, it is possible to independently measure the rod's orientation and tip position during the movement trial, using force platform derived data exclusively, and to compare these estimates to rod orientation and tip position estimates derived exclusively from the motion capture component. The degree of spatial and temporal agreement between these two sets of data provides an assessment of the joint working status of the kinetic and kinematic systems. A small number of variable are calculated and presented for inspection&emdash;these enable the user to detect the presence of errors from a large number of potential sources.

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