# Inspect3D Getting Started Overview

The purpose of this section is to orient new users to Inspect3D's user interface and the general functions available for processing motion capture data. Detailed information on using Inspect3D is provided through our documentation and step-by-step tutorials.

This section assumes that you have already installed and activated.

## Walkthrough

See how to load an existing CMO library, normalize all signals in the Link Model Based folder (ex. Joint Angles, Moments, etc.), average left and right sides together, then calculate, plot and export the mean data, all done in under five minutes.

Example.mp4

## Loading Data

Inspect3D uses the CMO Library to read data. Each subject/session should have a CMZ file created by Visual3D, and Inspect3D should point to the root directory.

Inspect3DIntroduction_CMO_Library.mp4

## Manually Grouping Data

Once the CMO Library path is defined, you can define queries to indicate which signals you want to analyze and how you want them grouped (ex. average all right/left sagittal ankle angles for treadmill trials). Data can be grouped based on tags, events, signals or expressions.

Examples of common groupings are:

- Right & Left signals (e.g., for a control data base)
  - Grouping that Right Ankle Angle and Left Ankle Angle signals
- Affected/Unaffected
  - Grouping Affected Right Ankle Angle and Affected Left Ankle Angle signals for comparison against Unaffected Right Ankle Angle and Unaffected Left Ankle Angle signals
- Sport-specific
  - Grouping signals based on a baseball player's Pitching Side versus their Non-pitching side

Inspect3DIntroduction_DefiningGroups.mp4

## Auto-generating Groups

Defining the signals you are interested in analyzing may be tedious, so an automatic signal

generation tool is available. Group names can be modified or removed after they've been defined.
Inspect3DIntroduction_AutoGroups.mp4

## Plotting and Inspecting Data

Once you have grouped the signals, you can easily plot them as individual traces, workspace means, or group means. You can click on specific cycles and choose to exclude them from analysis. This is an incredibly important **quality assurance step**.

Inspect3DIntroduction_PlottingData.mp4

## Working with Metrics

Inspect3D allows you to view and analyze metric data calculated in Visual3D on bar charts.

Inspect3DIntroduction_Metrics.mp4

## Exporting Results

Normalized signal data or metrics such as max/min can be exported to a text file. Text data can be exported in the default Visual3D text file format, but other formats are available as well.

Inspect3DIntroduction_Exporting.mp4

## Principal Component Analysis (PCA)

A key capability of Inspect3D is to perform waveform-based Principal Component Analysis (PCA) on your data. Waveform-based PCA is a multivariate statistical analysis technique that reduces a high-dimensional matrix of correlated, time-varying signals into a low-dimensional and statistically uncorrelated set of principal components (PCs). This PCA technique was developed in collaboration with Dr. Kevin Deluzio at Queen's University and follows the description in Research methods in Biomechanics. Our implementation of Principal Component Analysis is based on the article:

Deluzio KJ and Astephen JL (2007) Biomechanical features of gait waveform data associated with knee osteoarthritis. An application of principal component anslysis. Gait & Posture 23. 86-93 (pdf)

| Abstract |
|---|

This study compared the gait of 50 patients with end-stage knee osteoarthritis to a group of 63 age-matched asymptomatic control subjects. The analysis focused on three gait waveform measures that were selected based on previous literature, demonstrating their relevance to knee osteoarthritis (OA): the knee flexion angle, flexion moment, and adduction moment. The objective was to determine the biomechanical features of these gait measures, related to knee osteoarthritis. Principal component analysis was used as a data reduction tool, as well as a preliminary step for further analyses to determine gait pattern differences between the OA and the control groups. These further analyses included statistical hypothesis testing to detect group differences, and discriminant analysis to quantify overall group separation and to establish a hierarchy of discriminatory ability among the gait waveform features at the knee. The two groups were separated with a misclassification rate (estimated by cross-validation) of 8%. The discriminatory features of the gait waveforms were, in order of their discriminatory ability: the amplitude of the flexion moment, the range of motion of the flexion angle, the magnitude of the flexion moment during early stance, and the magnitude of the adduction moment during stance.

For a step-by-step example of how to use Inspect3D PCA see our Principal Components Analysis Tutorial.

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