Knowledge Discovery in Inspect3D

Inspect3D is designed to be a tool that helps you, the user, discover useful knowledge from your data. This process of knowledge discovery is iterative, requiring users to collect, clean, and shape their data before performing analysis and then communicating their results. Each of these steps requires experience to be done well, the aim of this article is to outline the goal of each step, how Inspect3D lets you accomplish these goals, and to point you on to additional resources.

Collecting data

The first step in learning from your data is to collect that data and bring it all together for analysis. Challenges can arise here if the data you are interested in has been collected by different researchers in different locations over many years. No matter how complex your study is, questions about how data is collected, how meta-data and data are linked, how data is shared or centralized, and how data is protected should always be answered before you start collecting.

So you have established a data collection plan, worked hard to collect your data, and now you have an initial or complete data set to analyse. At this point you want to bring your data set under one roof and explore what you've collected to see what patterns and connections you can find. Inspect3D lets you do this by loading CMZ files which contain all of the .c3d files as a CMO library. Since the .c3d format is standard across biomechanics research, this lets you easily group your data according to collection session and trials and to import this data with only a few clicks. You can also include arbitrary metadata alongside your .c3d files by using the Build CMZs feature.

Read about the Directory Structure for Input Data to learn more about how to organize your data most efficiently.

Complete the tutorial for loading and viewing your data to see how you can get your data into Inspect3D and ready for analysis.

Cleaning data

The second step in learning from your data is to clean your data. If we're honest with ourselves, no dataset from the real-world is perfect. Sometimes sensors fail, gait events are incorrectly identified, or something else just goes wrong. That's why it's important to clean your data and confirm that every piece of data that you put into analysis is a piece of data that you trust. This is also a chance for you to make sure that you have all of the data you expect. If you're missing something, then it's time to go back and make sure it gets collected.

Inspect3D lets your visualize your data as individual traces, workspace means, or group means so that you can assess it in whichever way makes sense for you. You can click on a specific trace in the Queried Data subwindow in order to determine exactly which file and frames it comes from. You can animate specific traces to help your quality control process. And at the end of the day, you can choose to exclude specific traces from your dataset so that they are not included in your analysis.

Complete the tutorial for cleaning your data to learn more about these processes.

Shaping data

Now that you have a clean dataset in front of you, it's time to start analysing the data! But wait, because a single study can contain multiple questions and each question might be concerned with a different portion of your dataset. Before we can jump into analysis, we have to shape our data to make sure that we are getting the right “view” into our data to answer the question we have in mind.

Inspect3D lets you shape your data by querying the CMO library. A query defines which signals and traces you want to extract from the library and executing a query produces a group in the Queried Data subwindow. Inspect3D can automatically define queries for you or you can define your own custom queries based on tags, events, or expressions. Common signal groups include Left and Right signals, Affected and Unaffected sides, and Pitching vs. Non-pitching sides. Once you've defined your queries, you can save these as .q3d files for easy reuse and to help you track exactly how you performed your analysis. If you decide that you can't quite get the data you want from your queries or for some reason you can't work with it, try going back to the collection and cleaning stages of the process.

Read about Inspect3D's Group Definition dialog to learn more about how you can define and refine groups of signals.

Read about how to query multisubject data.

Performing analysis

Having queried your clean dataset to get exactly the traces and metrics that you wanted, now you're finally ready to start analysing. We learn a lot about analytical techniques in our courses and throughout our formal training, but it's only one of the five steps here. Even though this is what we often think of as the difficult work of research, you've already put in a lot of effort to get through the first three steps and get to this point! The type of analysis you perform is obviously going to depend on the question you're trying to answer and the dataset that you have. Inspect3D implements a range of common data analysis techniques such as summary statistics calculation, principal component analysis (PCA), and clustering algorithms, with new techniques being added. Sometimes your analysis will prompt new questions or new ways of looking at your data. Don't be afraid to go back to collecting or shaping your data to see what else you might find.

Complete the tutorial for performing PCA to see some of the different ways you can analyse your data.

Communicating results

Once your analysis has produced results, your last step is to communicate your findings to the wider world. Whether you're presenting to a collaborator, talking at a conference, or producing publication-ready figures, there is a lot to think about when communicating your results.

Inspect3D's different visualization tools all let you control over the colours, line styles, and axis labels used to allow you to produce the figures that you want. If more work is required, then you can export

your analysis results to a number of different text formats including Visual3D ASCII, P2D, and SPSS.

Complete the tutorial on reproducing a journal figure to learn how you can exert fine-grained control over your figures.

Complete the tutorial on exporting results to see the variety of options available.

Read about The misuse of colour in science communication to learn how properly chosen colour palettes help you report data variation, reduce complexity, and increase accessibility.

Visit Color Brewer for advice on choosing accessible colour palettes.

Visit The Data Visualization Catalogue to learn about the different ways you can visualize data, along with the pros and cons of each.

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