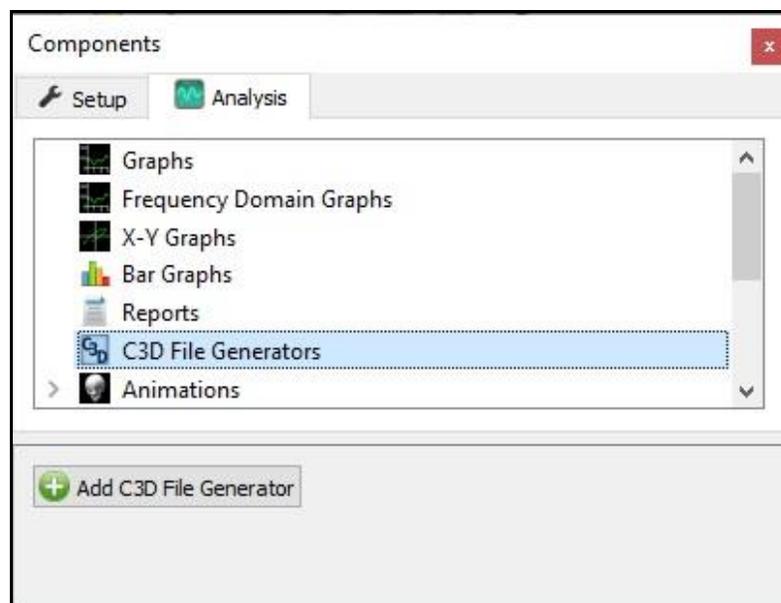


## The MotionMonitor xGen Software Guide: C3D Model Builder (C3D Export)

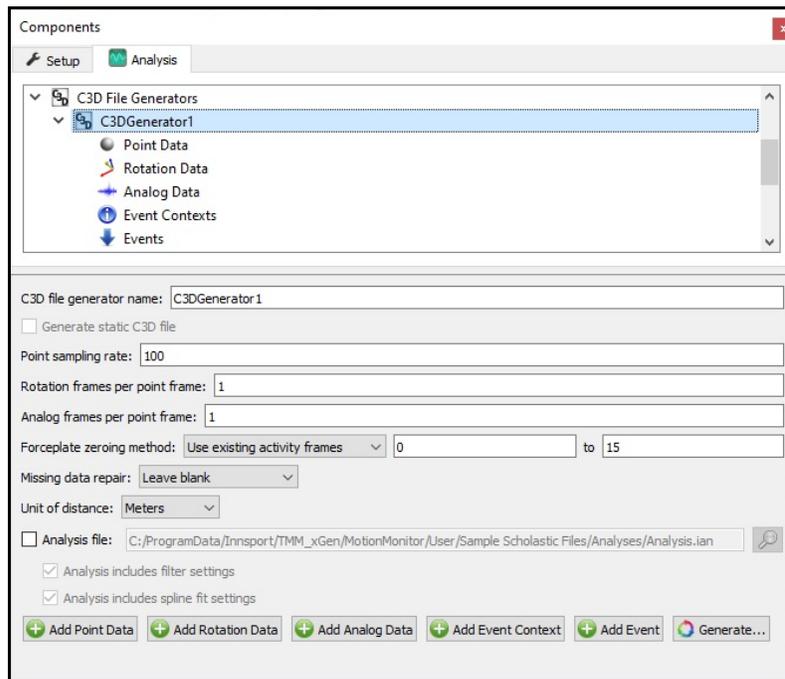
This guide reviews the procedure for exporting data from The MotionMonitor xGen activity files (\*.iac) in the C3D file format (\*.c3d). C3D files are a standard file format that allow for data to be shared between systems and software from different manufacturers and between researchers and labs. The C3D file format can contain various types of data including 3D motion data, rotation data, analog, EMG, and force plate data as well as additional information including force platform alignment in the global coordinate system and processed data and events. Exporting a C3D file must be performed in version 3.48e or later.

1. The process of generating or exporting a C3D file mirrors the process of generating or exporting data through a report (\*.txt). To define the data to be included within the C3D file, right-click on the “C3D File Generators” node in the Components Analysis tab and select the Add option or click on the “Add C3D File Generator” button in the parameters panel when the “C3D File Generators” node is selected.



The process of exporting C3D data can be performed from either within a specific activity file or the Live window. The advantage of generating C3D files from the Live window is that it can be performed as batch process, generating multiple C3D files at the same time.

2. Once a C3D File Generator has been added, the data to be included and the parameters for defining the C3D file can be specified. The image below shows the various data types that can be included in a C3D file, more on that later, as well as the parameters panel for the C3D Generator, which includes the general parameters for defining the C3D file.



Within the Parameters panel there are several settings that need to be defined prior to the export. The sampling interval for the position data is set in the *Point Sampling Rate* field. *Rotation* and *Analog* sampling rates can also be defined as a factor of the Point sampling interval. For example, if the Point data is sampled at 100 Hz and the *frames per point frame* is set to 10 for Analog data, this would result in a sampling interval of 1000 Hz for analog data.

Force plate data will automatically be exported when the analog channels that the force plate is connected to are included as *Analog data* in the export. Digital force plates will also be automatically exported; however, no further user intervention is required. Please contact a Client Support Engineer when exporting digital force plate data, to ensure the software version is compatible for this feature.

The C3D file specifications for force plates require a Zero parameter that may be used to provide a baseline for the force platform measurements. This parameter is intended to define the range of analog data that is expected to have no physical forces or moment present and allows an application that reads the force plate data to read the raw analog data for the given frames, find the mean for each channel, and then subtract it from the recorded analog data for the corresponding channel as it is accessed. It is recommended that "Zero" frames be at the start of the recording, as that is what some software applications expect, however the frame range for the "Zero" can be specified in this menu if that's not the case.

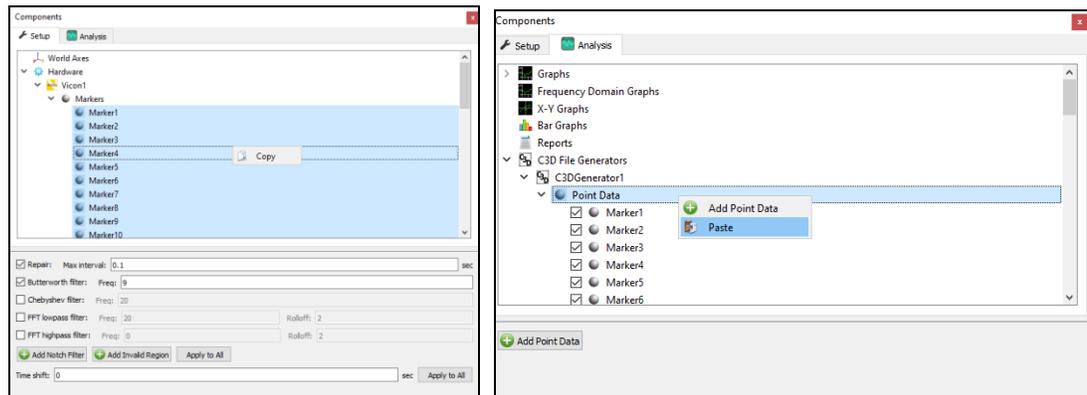
The way the software handles missing frames can be selected from the “Missing data repair” drop-down. Options include: **1.** Missing data can be left blank. **2.** The last value before the gap can be repeated until the data returns. **3.** A linear interpolation can be used to fill the gap.

The Unit of distance can also be select as meters, centimeters, millimeters, or inches.

When running a batch C3D export from the live window, an analysis file can be loaded to the export using the analysis file checkbox. Furthermore, checkboxes for the filters and spline fit settings saved in the analysis file can be enabled.

3. Data types that can be exported are outlined below. For all data types, a description and label can be defined. The description field allows the user to provide more extensive details on the variable being exported. A label is limited to 16 characters and is what will be primarily visible when importing the C3D file. Labels should be unique and easy to read, e.g. LASI and RASI.

Variables can be copied and pasted directly from the hardware components. For example (below) Vicon marker (Point) data can be copied directly into the C3D export by highlighting all of the markers, right clicking on these lines, and pasting into Point data field in the C3D generator field.

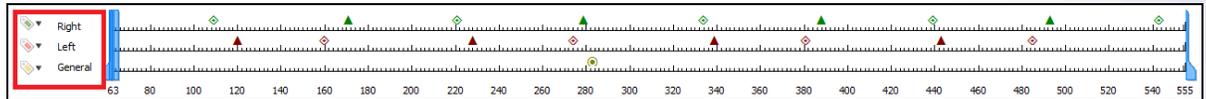


**Point Data:** The Point parameters group provides information about the 3D data contained within a C3D file as well as some basic information about the data environment (ie. global coordinate system). Point data is typically constrained to position data, such as data from raw marker/sensor measurement as well as anatomical landmarks and segment endpoints but can also include velocity and acceleration data or other user defined scalar values.

**Rotational Data:** The Rotational parameters group provides information about the 3D rotations between two axes recorded within a C3D file. This includes joint rotations between two segment axes or segment orientations relative to the world.

**Analog data:** The Analog parameters group stores information about the analog data recorded within a C3D file. Analog data must be included when exporting data for force plates but can also output events recorded with an analog receiver, EEG, EMG and more.

**Event Contexts:** This group provides names and descriptions for the contexts of named events in the C3D file that are stored in the EVENT group. For example, typical event contexts include Left side event, Right side event, and General event but other contexts can easily be created. See more information about events below.



**Events:** Events can be used to identify markers of interest in the data. For example, outputting events in the gait cycle like heel strike, toe-offs, etc.

Event label:	Event1
Event description:	Event1
Time offset:	Use drop-lists <no selection> no derivative
Event context:	EventContext1
Subject name:	Use formula
Icon ID:	Use formula 0
Generic flags:	Use formula 0

### Event: Labels

This field creates user defined strings, one for each event, that stores a label entry associated with each stored event ie. Foot Strike, Foot Off etc. When used with the appropriate **Events Contexts** value this can identify an event as Left Foot Strike or Right Foot Off etc.

### Event: Descriptions

This field stores a description for each event. This can be a long event definition (for example, "The moment any part of the foot first contacts the floor during a gait cycle") or a simple descriptive string like Heel Contact.

### Event: Times

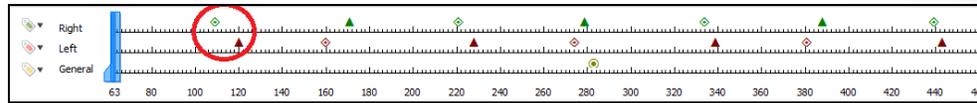
This field stores the time of each event from the start of the trial where the first 3D sample (frame 1) is time 0.0. The time is defined as minutes & seconds. The "Time offset" field is expecting a Scalar value to indicate the time an event occurred.

### Event: Subjects

This field allows users to identify different subjects in the recording when more than one was present. This field can be left blank if only a single subject was present in the recording.

### Event: Icon IDs

This field allows an application to identify the icons associated with each event as defined in the **Event Descriptions** parameters. This field is expecting an Integer value.



### Event: Generic Flags

This field allows users to identify generic user defined events that are not specific to event contexts and labels. For example, a generic flag can be a marker of interest outside of the gait events previously defined (ie. auditory stimulus presented to the subject during the recording). This field is expecting an Integer value.

4. Once all settings are configured, the **Generate** button can be used to proceed with the C3D file(s) export. Data will be export to the User *Export* folder in the *C:\ProgramData\Innsport\TMM\_xGen\MotionMonitor\User* directory.

For more information on C3D files and its contents, please refer to [The C3D File Format: A Technical User Guide by Motion Lab Systems.](#)