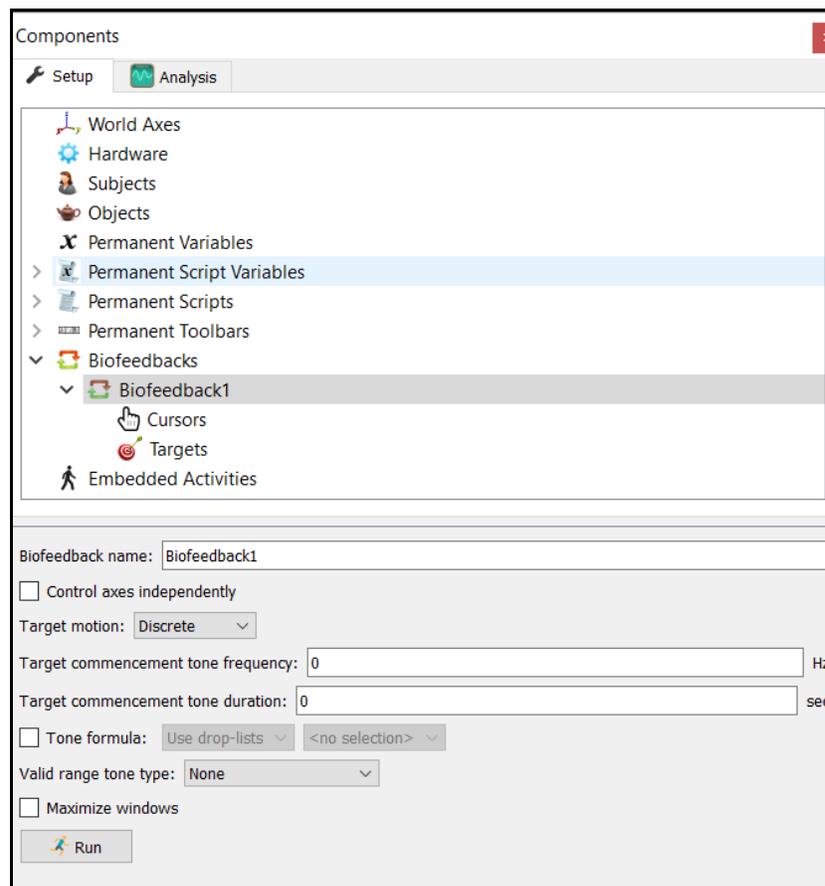


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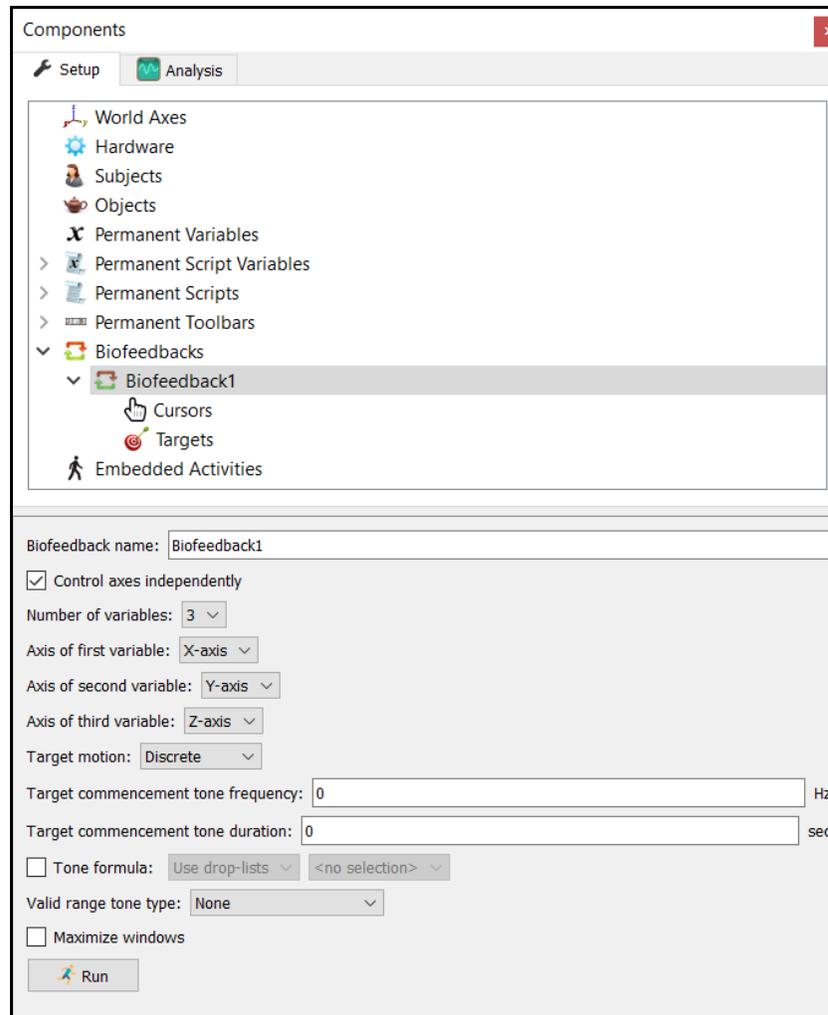
This document outlines the real-time biofeedback features that *The MotionMonitor xGen* can provide through visual and auditory cues. The Biofeedback component includes the framework for quickly and easily implementing cursor-target conditions commonly used in participant training paradigms and event contingent stimulus-response studies. To add a biofeedback protocol right click on the *Biofeedback* node and select *Add Biofeedback*. Note that you must be released for the Biofeedback software module to add a Biofeedback. The ability to control axes independently was a feature added in version 3.82. If you would like to update to this version, please speak to your Client Support Engineer for further details.



The “Maximize Window” option allows users to present the biofeedback Animation window on a full screen without toolbars or titles. If this option is selected, the maximized window will be presented on the Main Display (selected via the computer’s display settings) until the Biofeedback recording is completed.

Targets can be discrete or random. Both options are described below. A target commencement tone can be provided any time a new target appears. The frequency and duration of this commencement tone can be specified in the menu above. A user defined tone formula can also be enabled. For example, if the subject is within valid range of the target for a specified amount of time, a tone can be provided as feedback on their performance. This tone can be provided as a constant frequency or proportional frequency based off the target-cursor error.

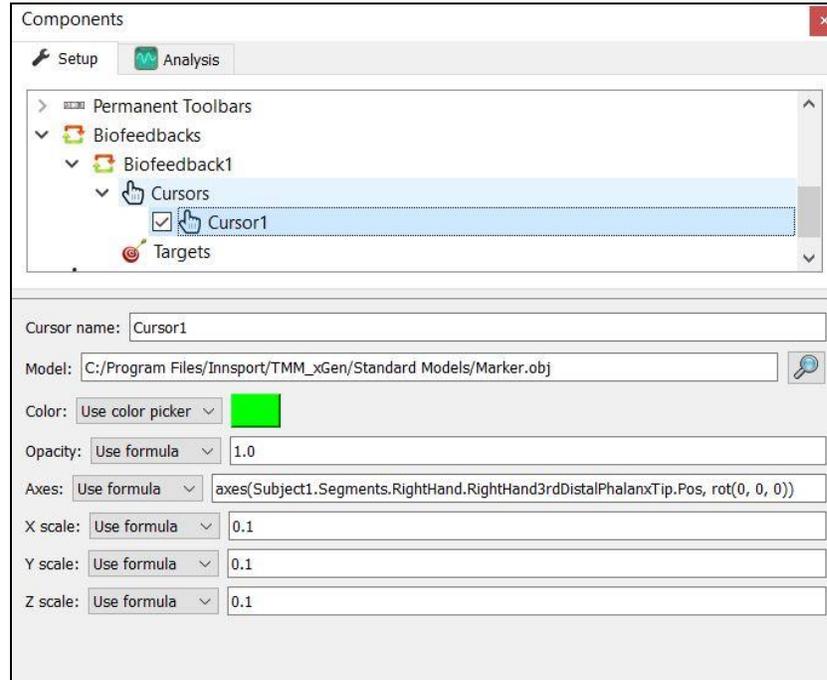
The Control axes independently check box, when checked provides the user with additional options: the ability to uniquely define 1-3 variables, and specify which variable is the first, second and third axis. Selections made here will impact the choices available under the cursor and target menus. Available options for both selections of the Control axes independently checkbox will be provided throughout the following steps.



The Biofeedback recording is started by clicking the Run button at the bottom of this menu or through the Recording Script function `RunBiofeedback()`.

The length of the Biofeedback recording is determined by the settings specified within the Recording Parameters dialog, be sure to set these parameters in advance of running the biofeedback. You may do this from the Edit Parameters Icon  or from Record>Edit Recording Parameters. Or you can specify a length of a recording from within a script.

Cursor Menu



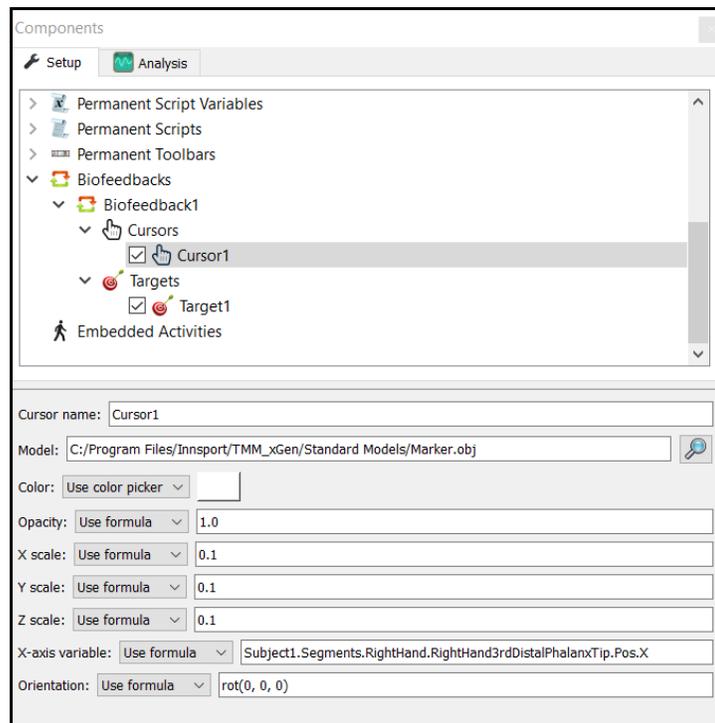
Cursors can be added by right clicking on the *Biofeedback1/Cursors* node or by clicking on the “Add Cursor” button at the bottom of this menu. Multiple cursors can be added if desired. Once added, select the cursor to view and modify its properties.

The parameters panel above shows the settings when the control axes independently option is disabled. The cursor model can be selected by mapping to the desired object file (ie. sphere, cube, etc.). In the example above the cursor will appear in the biofeedback window as a green sphere. The color can be selected by using the color picker menu or through a formula. Color can also be controlled using real-time data. For example, color can change based on the proximity to the target. The opacity of the cursor can be controlled, where 0 is not visible, 1 is opaque and everything in between (ie. 0.5) is varying levels of transparency.

Cursor movement is controlled based on the axes edit field. Its vector position and orientation can be controlled using an axes formula. In the example above the cursor position is controlled by the subject’s fingertip position in the space. Any defined variables can be used to control the XYZ position and rotations of the cursor.

The size of the cursor can be controlled using the XYZ scale fields. Scaling will depend on the units of the variables used to define the cursor and targets. Certain variables may have a larger scale compared to others. This would require that you “view” them from a further distance in the animation. For example, angles (degrees) have a larger working range compared to position (meters), as it’s not likely that the subject will move through 90 meters in space during the recording but can easily have joint motion past 90 degrees of rotation.

Or with the control axes independently option enabled, the edit fields for the individual Cursor axes (Number of variables) that were enabled will be available below the scale values and a definition may also be provided to the orientation, if desired.



Discrete Targets Menu

Components

Setup Analysis

- ▼ Biofeedback1
 - > Cursors
 - ▼ Targets
 - ☑ Target1
 - Embedded Activities

Target name: Target1

Model: C:/Program Files/Innsport/TMM_xGen/Standard Models/Marker.obj

Color: Use color picker

Opacity: Use formula 1.0

Axes: Use formula axes(vec(0, 0, 0), rot(0, 0, 0))

X scale: Use formula 1.0

Y scale: Use formula 1.0

Z scale: Use formula 1.0

End-of-target formula: Use formula

Minimum duration: 10 sec

Maximum duration: 10 sec

Transition type: Smooth

Transition period: 2 sec

X margin: Use formula 0.1

Y margin: Use formula 0.1

Z margin: Use formula 0.1

Commencement tone

The parameters panel above shows the settings when the control axes independently option is disabled. Like the cursor, target name, model, color, axes (position & orientation) and XYZ scale can be specified in the first section of the menu. Each added target can be unique in these fields.

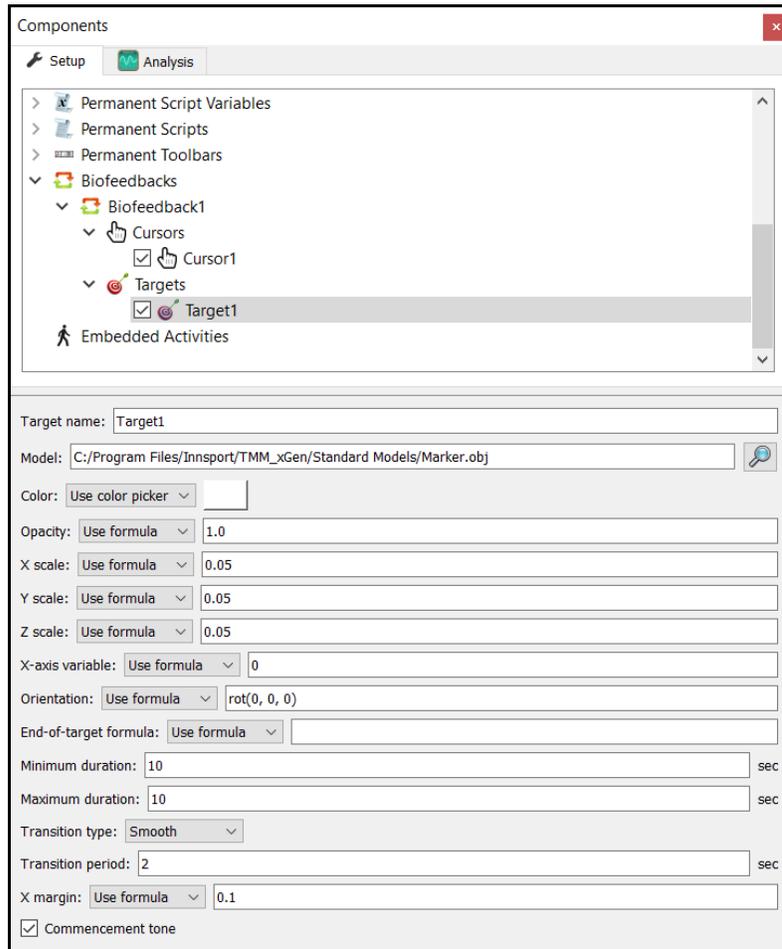
The duration of the target's position will be based on the minimum and maximum duration settings. If the min and max durations differ, the target will be present in that location for a random amount of time within these parameters. If they are set to match (as is the case in the example above), the target will be present in that location for the set time (ie. 10 seconds).

An end of target formula can also be defined to control when the current target moves to its next position. For example, if the cursor is within a specified margin of the target for X amount time, it will override the duration settings and move to the next position. If these conditions are not met, then the target will remain in the current position until the min/max duration parameters are met.

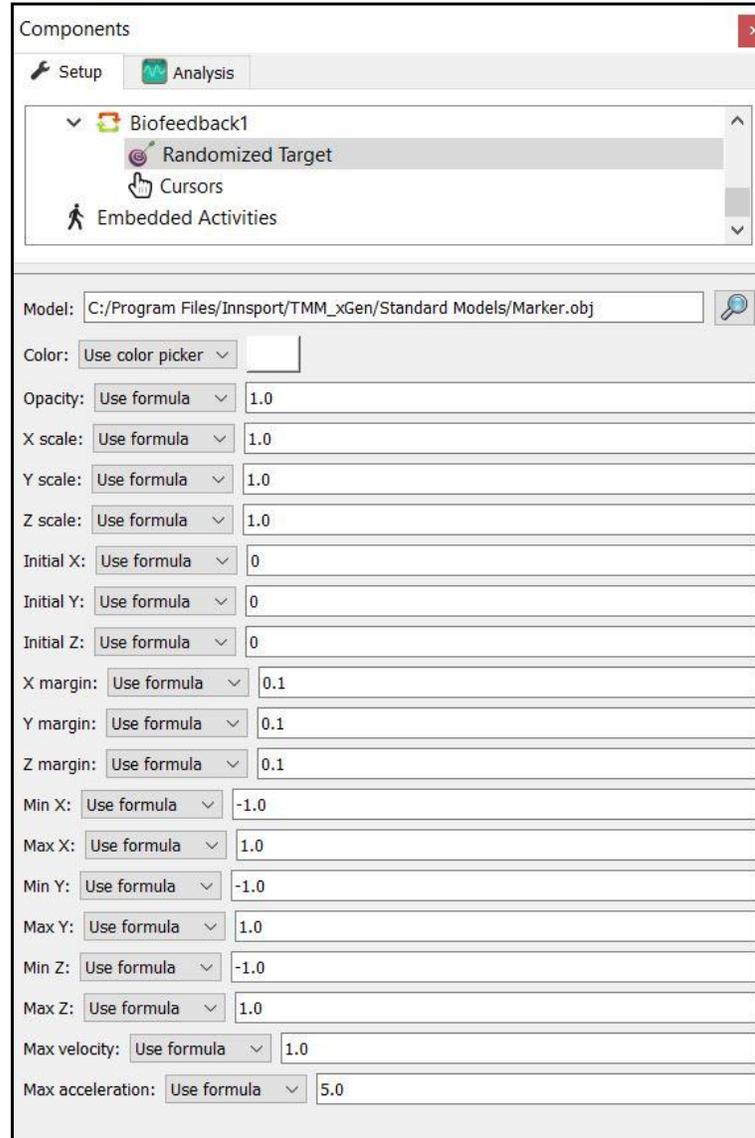
There are four different methods for a target to transition to the next location. A *Smooth* transition will translate the target from the current location to the next based on the rate set in the Transition Period field (in sec). If *Instantaneous* is selected the target will jump from the current location to the next. *Persistent* will keep the target visible after the target has moved on to the next location. *Permanent* will present the target from the start of the biofeedback recording to the end.

Setting XYZ margins allows users to define valid ranges from the center of the target. It allows users to signal/output auditory tones if the target is within the margins (see page 1). The commencement tone can also be enabled or disabled for each target individually (see page 1).

Or with the control axes independently option enabled, there will be editable fields for each of the individual axes that were enabled, as seen below.



Random Targets Menu



The screenshot shows the 'Components' window with the 'Analysis' tab selected. Under 'Biofeedback1', the 'Randomized Target' component is highlighted. Below the component list, the 'Model' field is set to 'C:/Program Files/Innsport/TMM_xGen/Standard Models/Marker.obj'. The 'Color' field is set to 'Use color picker'. The 'Opacity' field is set to 'Use formula' with a value of 1.0. The 'X scale', 'Y scale', and 'Z scale' fields are all set to 'Use formula' with a value of 1.0. The 'Initial X', 'Initial Y', and 'Initial Z' fields are all set to 'Use formula' with a value of 0. The 'X margin', 'Y margin', and 'Z margin' fields are all set to 'Use formula' with a value of 0.1. The 'Min X', 'Max X', 'Min Y', 'Max Y', 'Min Z', and 'Max Z' fields are all set to 'Use formula' with values of -1.0 and 1.0 respectively. The 'Max velocity' field is set to 'Use formula' with a value of 1.0. The 'Max acceleration' field is set to 'Use formula' with a value of 5.0.

Target model, color, opacity, XYZ scale & margins serve the same purpose as with the discrete target settings.

The Initial XYZ field defines the start coordinates/location where the target is presented in the space. The target will then move randomly in the space at a max velocity and acceleration specified in the corresponding edit fields at the bottom of the menu. Spatial constraints can be set for the target movement by defining minimum and maximum XYZ limits. Control options will be reduced if only one or two variables are selected when choosing control axes independently.