MPCO Recorder

The MPCO recorder type records the response of a number of nodes and/or elements at every (or some) converged step. Results are stored in a HDF5 database [1].
The MPCO recorder is developed by ASDEA Software Technology (https://asdeasoft.net/) to produce a result database that can be read by the pre/post-processor STKO (Scientific ToolKit for OpenSees, https://asdeasoft.net/stko/). However the output file is a HDF5 database, so it can also be read/edited by any other tool that can handle HDF5 databases.
The command to create a MPCO recorder is:

recorder mpco $fileName <-N $nodeRespType1 $nodeRespType2 …> <-E $elemRespType1 $elemRespType2 …> <-NS $nodeSensRespType1 $sensParam1 $nodeSensRespType2 $sensParam2 … > <-R $regionTag> <-T dt $deltaTime> <-T nsteps $numSteps>

<table>
<tr><td>$fileName</td><td>Name of file to which output is sent.</td></tr>
<tr><td>-N</td><td>Optional, used to start the list of node responses to record</td></tr>
<tr><td>$nodeRespType1
$nodeRespType2 …</td><td>Strings indicating required node responses. Response types are given in table below:
<table>
<tr><td>displacement</td><td>Translational part of the displacement field</td></tr>
<tr><td>rotation</td><td>Rotational part of the displacement field</td></tr>
<tr><td>velocity</td><td>Translational part of the velocity field</td></tr>
<tr><td>angularVelocity</td><td>Rotational part of the velocity field</td></tr>
<tr><td>acceleration</td><td>Translational part of the acceleration field</td></tr>
<tr><td>angularAcceleration</td><td>Rotational part of the acceleration field</td></tr>
<tr><td>reactionForce</td><td>Translational part of the reaction field</td></tr>
<tr><td>reactionMoment</td><td>Rotational part of the reaction field</td></tr>
<tr><td>reactionForceIncludingInertia</td><td>Translational part of the reaction field with inertia terms</td></tr>
<tr><td>reactionMomentIncludingInertia</td><td>Rotational part of the reaction field with inertia terms</td></tr>
<tr><td>rayleighForce</td><td>Translational part of the damping force field</td></tr>
<tr><td>rayleighMoment</td><td>Rotational part of the damping force field</td></tr>
<tr><td>pressure</td><td>Pore pressure field</td></tr>
<tr><td>modesOfVibration</td><td>Translational part of the eigenvector fields (all modes are recorded)</td></tr>
<tr><td>modesOfVibrationRotational</td><td>Rotational part of the eigenvector fields (all modes are recorded)</td></tr>
</table></td></tr>
<tr><td>-E</td><td>Optional, used to start the list of element responses to record</td></tr>
<tr><td>$elemRespType1
$elemRespType2 …</td><td>Strings indicating required element responses. Valid response types depend on the element/section/material.
Assuming “RES” is a valid response type for some elements in the model:
• RES will record the element result “RES”. In this case “RES”</td></tr>
</table>

<table>
<tr><td></td><td>must be a valid response for the element.
• material.RES will record the material result “RES” for each integration point in continuum elements. In this case “RES” must be a valid response for the materials assigned to the element’s integration points.
• section.RES will record the section result “RES” for each section in structural elements (truss, beams, shells, etc..). In this case “RES” must be a valid response for the sections assigned to the element’s integration points.
• section.fiber.RES will record the material result “RES” for each fiber in each section in structural elements (beams or shells). In this case “RES” must be a valid response for the material assigned to the fibers of the fiber cross section at the element’s integration points.</td></tr>
<tr><td>-NS</td><td>Optional, used to start the list of node sensitivity responses to record</td></tr>
<tr><td>$nodeSensRespType1
$nodeSensRespType2 …</td><td>Strings indicating required node sensitivity responses. Each string must be followed by an integer indicating the associated sensitivity parameter. Response types are given in table below:
<table>
<tr><td>displacementSensitivity</td><td>Translational part of the displacement sensitivity field</td></tr>
<tr><td>rotationSensitivity</td><td>Rotational part of the displacement sensitivity field</td></tr>
<tr><td>velocitySensitivity</td><td>Translational part of the velocity sensitivity field</td></tr>
<tr><td>angularVelocitySensitivity</td><td>Rotational part of the velocity sensitivity field</td></tr>
<tr><td>accelerationSensitivity</td><td>Translational part of the acceleration sensitivity field</td></tr>
<tr><td>angularAccelerationSensitivity</td><td>Rotational part of the acceleration sensitivity field</td></tr>
</table></td></tr>
<tr><td>$sensParam1
$sensParam2 …</td><td>Integers indicating required node sensitivity parameters. Each integer must be preceded by a string indicating the associated sensitivity response.</td></tr>
<tr><td>-R</td><td>Optional, used to specify a region of the model to be recorded. If omitted (Default) the recorder will record the whole model.</td></tr>
<tr><td>$regionTag</td><td>The tag of a previously defined region.</td></tr>
<tr><td>-T dt</td><td>Optional, used to specify the time interval for recording. If omitted, the recorder will record every time step.</td></tr>
<tr><td>$deltaTime</td><td>Time interval for recording. Will record when next step is $deltaTime greater than last recorder step</td></tr>
<tr><td>-T nsteps</td><td>Optional, used to specify the step interval for recording. If omitted, the recorder will record every time step.</td></tr>
<tr><td>$numSteps</td><td>Time step interval for recording. Will record every $numSteps steps.</td></tr>
</table>

RETURNS
>0 an integer tag that can be used as a handle on the recorder for the remove recorder command.
-1 recorder command failed if integer -1 returned.

NOTES

- The MPCO recorder needs the HDF5 library version 1.10 be installed on the target machine. The HDF5 shared library is loaded at run-time the first time the MPCO recorder is created. The HDF5 shared library must be “visible” to the opensees executable (i.e. in the same directory of the opensees executable or in a known path where the system searches for shared libraries).
- Options <-T dt $deltaTime> and <-T nsteps $numSteps> are mutually exclusive. If you define the -T option more than once, only the last one will be considered.
- Option -R (record region instead of recording the whole model) can be used multiple times. If this option is used multiple times (say -R 1 -R 2 -R 3), then the subset of the model that will be recorded is the union of regions 1, 2 and 3 (1 U 2 U 3) both for nodes and elements.

EXAMPLES

Example 1:
```
recorder mpco "fiber_beams.mpco" \
 -N displacement rotation reactionForce reactionMoment modesOfVibration \
 -E force section.force section.fiber.stress
```

This example creates the HDF5 database “fiber_beams.mpco”. It records the following node responses: displacement, rotation, reactionForce, reactionMoment and modesOfVibration. Furthermore it records the following element responses: force (forces at element nodes), section.force (generalized beam forces at each section in local coordinate system), and section.fiber.stress (uniaxial stress field in each fiber of each section of the elements).

Example 2:
```
recorder mpco "fiber_beams.mpco" \
 -N displacement rotation reactionForce reactionMoment modesOfVibration \
 -E force section.force section.fiber.stress \
 -R 1
```

Same as example 1, but records only nodes and elements in region 1 of the model.

Example 3:
```
recorder mpco "fiber_beams.mpco" \
 -N displacement rotation reactionForce reactionMoment modesOfVibration \
 -E force section.force section.fiber.stress \
 -R 1 \
 -T dt 0.01
```

Same as example 2, but records a step only if the domain time of the current step minus the domain time of the previous recorded step is greater then 0.01 seconds.