

Time Dependent Statistics and Relational Analysis

RAVEN Workshop

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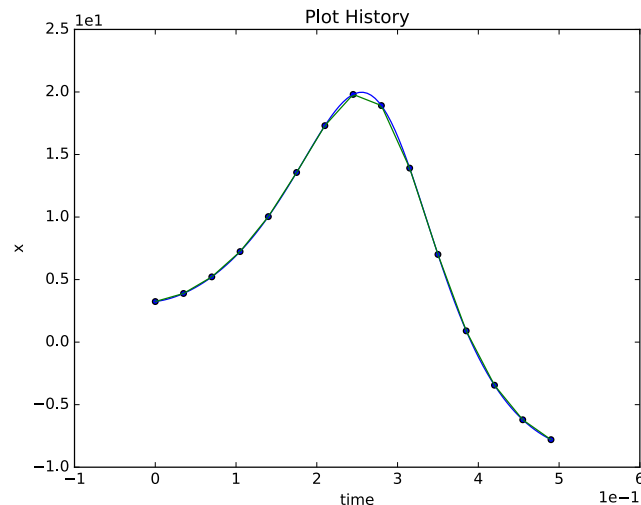


Overview

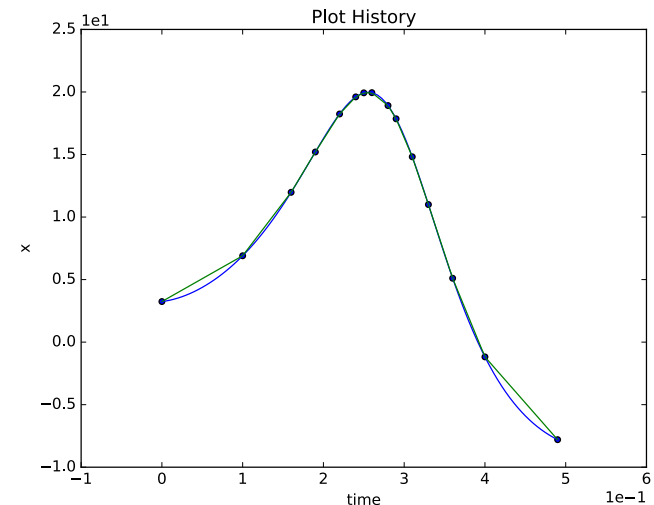
- Time-series post-processors:
 - Quick overview
- Time dependent basic statistics
 - Scalar FOMs
- Time dependent relational analysis
 - Relational FOMs

Data Pre-Processing: Re-Sampling

- **Objective:** reduce memory space of each time series
- **Method:** re-sampling the time series
 - Smartly locate sample points on strategically important regions
 - e.g. high derivative (gradient) regions



Uniform sampling



First-order derivative sampling

RAVEN Time-Series Post-Processors

- Class: Interfaced Post-Processors
 - RAVEN provides a generic interface to create user-defined generic Post-Processors
 - Act on both PointSets and HistorySets

RAVEN Time-Series Post-Processors: Examples

- ~~HSPS~~: it converts an HistorySet into a PointSet
 - Each history is converted into a multi-dimensional vector
- ~~HistorySetSampling~~
 - Original HistorySet is re-sampled accordingly to a specific sampling strategy
- ~~HistorySetSync~~
 - Time series contained in the original HistorySet are synchronized in time
 - Identical initial and final time
 - Identical number of samples
- ~~dataObjectLabelFilter~~
 - Filter the dataObject for a specific value of the clustering label

RAVEN Example 1

Time Dependent Basic Statistics – Scalar FOMs

RAVEN Scalar FOMs

- **Scalar FOMs**
 - Expected value
 - Variance
 - Sigma
 - Kurtosis
 - Skewness
 - Variational Coefficient
 - Median
 - Percentile (e.g. 5%, 95%, etc.)
 - Etc.

RAVEN Example 1: Time-Dep. Basic Statistics

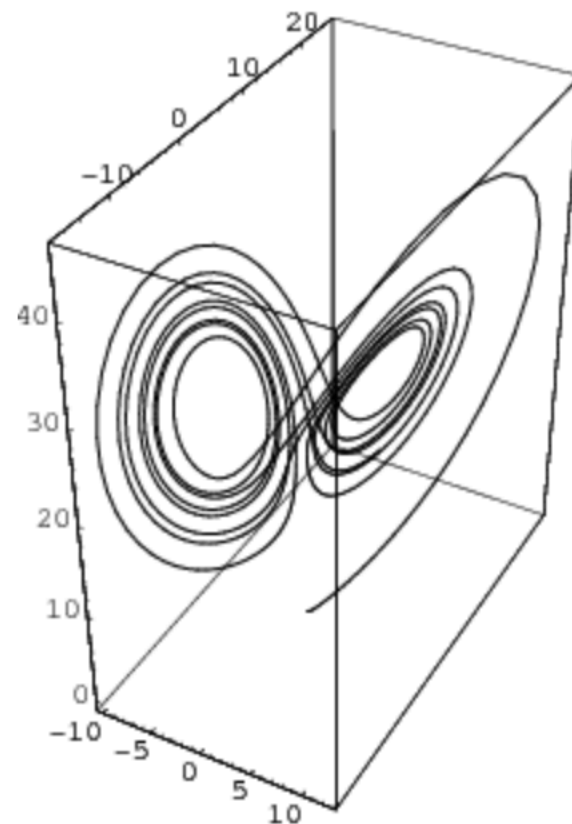
- Steps
 1. Generate time-dependent data
 2. Post-Process the data (scalar FOMs)
 3. Create a DataObject (PointSet) from processed data

RAVEN Example 1: Time-Dep. Basic Statistics

Distributions	Models	Samplers	Databases	DataObjects	Steps
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```

<Models>
...
<PostProcessor name="timeDepBasicStat" subTy
  <pivotParameter>time</pivotParameter>
  <expectedValue>x,y,z</expectedValue>
  <percentile_5>x,y,z</percentile_5>
  <percentile_95>x,y,z</percentile_95>
</PostProcessor>
<PostProcessor name="readStats" subType="Rav
  <dynamic>true</dynamic>
  <File ID="0" name="output_TD_BS.xml">
    <output name="mean" >x | expect
    <output name="percentile_5" >x | percen
    <output name="percentile_95" >x | percen
  </File>
</PostProcessor>
</Models>
  
```



RAVEN Example 1: Time-Dep. Basic Statistics

Distributions	Models	Samplers	Databases	DataObjects	Steps
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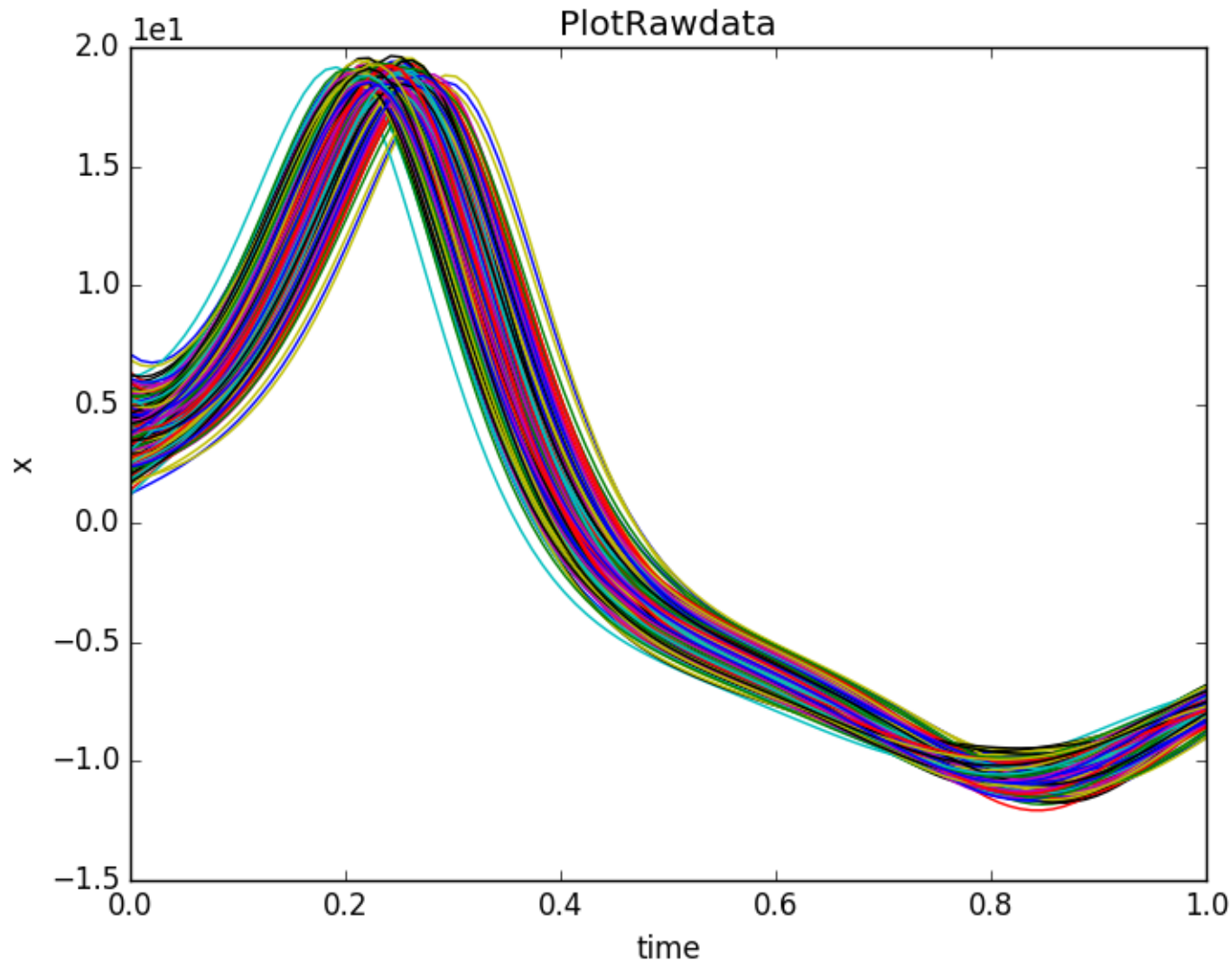
```

<Steps>
  <MultiRun name="FirstMRun">
    <Input      class="DataObjects"  type="PointSet"      >inputPlaceholder</Input>
    <Model      class="Models"       type="ExternalModel" >PythonModule</Model>
    <Sampler    class="Samplers"     type="MonteCarlo"    >MC_external</Sampler>
    <Output     class="DataObjects"   type="HistorySet"    >HistorySet</Output>
  </MultiRun>
  <PostProcess name="timeDepBasicStatPP">
    <Input      class="DataObjects"   type="HistorySet"    >HistorySet</Input>
    <Model      class="Models"       type="PostProcessor" >timeDepBasicStat</Model>
    <Output     class="Files"        type=""              >output_TD_BS.csv</Output>
    <Output     class="Files"        type=""              >output_TD_BS.xml</Output>
    <Output     class="DataObjects"   type="HistorySet"    >HistorySet</Output>
  </PostProcess>
  <PostProcess name="readStats">
    <Input      class="Files"        type=""              >output_TD_BS.xml</Input>
    <Input      class="DataObjects"   type="HistorySet"    >HistorySet</Input>
    <Model      class="Models"       type="PostProcessor" >readStats</Model>
    <Output     class="DataObjects"   type="PointSet"      >stats</Output>
    <Output     class="OutStreams"    type="Plot"          >Plotdata</Output>
    <Output     class="OutStreams"    type="Plot"          >PlotRawdata</Output>
  </PostProcess>
</Steps>

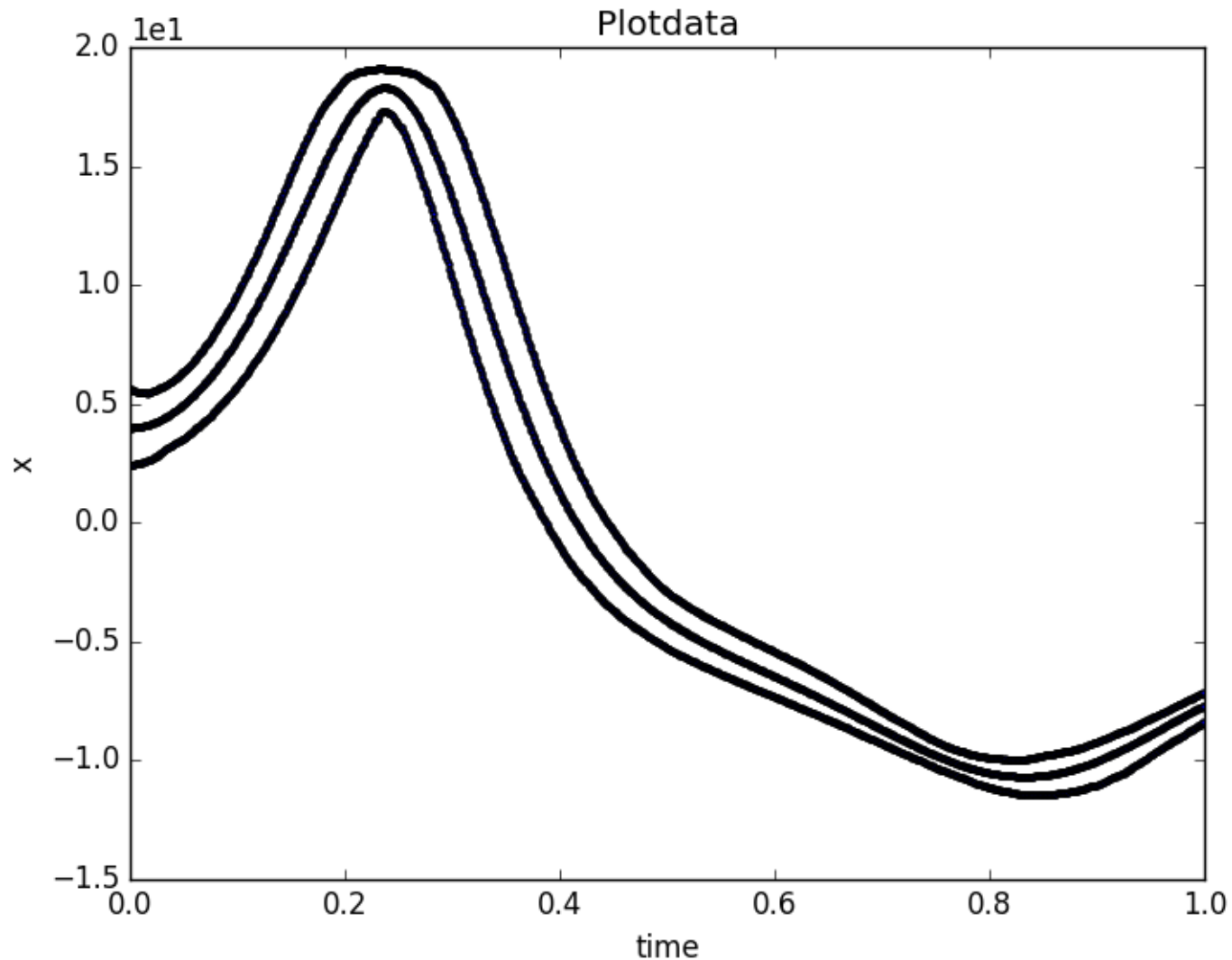
```

Input file name: time_dep.xml

RAVEN Example 1: Time-Dep. Basic Statistics



RAVEN Example 1: Time-Dep. Basic Statistics



RAVEN Example 2

Time Dependent Basic Statistics – Relational FOMs

RAVEN Scalar FOMs

- Relational FOMs
 - Sensitivity (linear regression) coefficients
 - Covariance coefficients
 - Correlation coefficients (Pearson)
 - Normalized sensitivity coefficients
 - Variance Weighted Sensitivity coefficients
 - Etc.

RAVEN Example 2: Time-Dep. Basic Statistics

- Steps
 1. Generate time-dependent data
 2. Post-Process the data (relational FOMs)
 3. Create a DataObject (PointSet) from processed data

RAVEN Example 2: Time-Dep. Basic Statistics

Distributions	Models	Samplers	Databases	DataObjects	Steps
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```

<Models>
...
<PostProcessor name="timeDepBasicStat" subType="BasicStatistics">
  <covariance>
    <features>x0,y0,z0,x,y,z</features>
    <targets>x,y,z</targets>
  </covariance>
  <pearson>
    <features>x0,y0,z0,x,y,z</features>
    <targets>x,y,z</targets>
  </pearson>
  <!--! We are going to build the sensitivity block -->
  <sensitivity>
    <features>x0,y0,z0,x,y,z</features>
    <targets>x,y,z</targets>
  </sensitivity>
</PostProcessor>
...
</Models>

```


RAVEN Example 2: Time-Dep. Basic Statistics

Distributions	Models	Samplers	Databases	DataObjects	Steps
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```

<Models>
...
<PostProcessor name="readStats" subType="RavenOutput">
  <dynamic>true</dynamic>
  <File ID="0" name="output_TD_BS.xml">
    <output name="pearson_x0_x" > x0 | pearson | x </output>
    <output name="pearson_y0_y" > y0 | pearson | y </output>
    <output name="pearson_z0_z" > z0 | pearson | z </output>
    <output name="pearson_x_y" > x | pearson | y </output>
    <output name="pearson_x_z" > y | pearson | z </output>
    <output name="covariance_x0_x" > x0 | covariance | x </output>
    <output name="covariance_y0_y" > y0 | covariance | y </output>
    <output name="covariance_z0_z" > z0 | covariance | z </output>
    <output name="covariance_x_y" > x | covariance | y </output>
    <output name="covariance_x_z" > y | covariance | z </output>
    <!-- we are going to add the sensitivity here-->
  </File>
</PostProcessor>
</Models>
  
```

RAVEN Example 2: Time-Dep. Basic Statistics

Distributions	Models	Samplers	Databases	DataObjects	Steps
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```

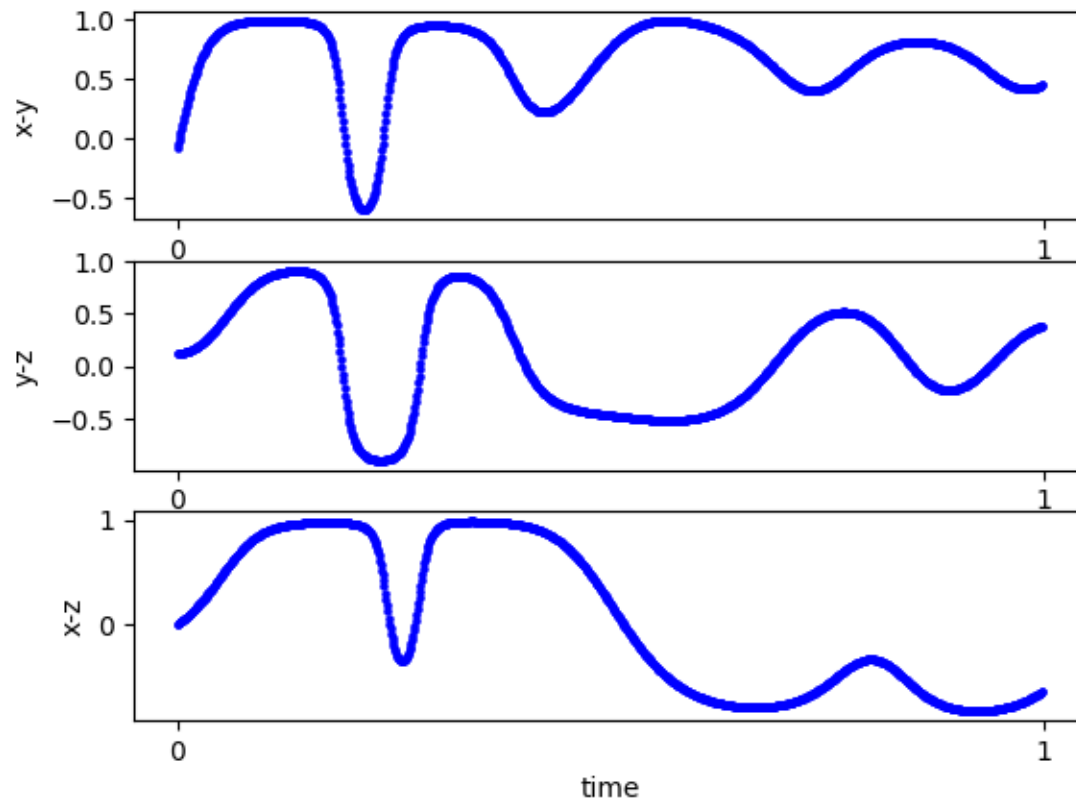
<Steps>
  <MultiRun name="FirstMRun">
    <Input      class="DataObjects"  type="PointSet"      >inputPlaceholder</Input>
    <Model      class="Models"       type="ExternalModel" >PythonModule</Model>
    <Sampler    class="Samplers"     type="MonteCarlo"    >MC_external</Sampler>
    <Output     class="DataObjects"   type="HistorySet"    >HistorySet</Output>
  </MultiRun>
  <PostProcess name="timeDepBasicStatPP">
    <Input      class="DataObjects"   type="HistorySet"    >HistorySet</Input>
    <Model      class="Models"       type="PostProcessor" >timeDepBasicStat</Model>
    <Output     class="Files"        type=""              >output_TD_BS.csv</Output>
    <Output     class="Files"        type=""              >output_TD_BS.xml</Output>
    <Output     class="DataObjects"   type="HistorySet"    >HistorySet</Output>
  </PostProcess>
  <PostProcess name="readStats">
    <Input      class="Files"         type=""              >output_TD_BS.xml</Input>
    <Input      class="DataObjects"   type="HistorySet"    >HistorySet</Input>
    <Model      class="Models"       type="PostProcessor" >readStats</Model>
    <Output     class="DataObjects"   type="PointSet"      >stats</Output>
    <Output     class="OutStreams"    type="Plot"          >Plotdata</Output>
    <Output     class="OutStreams"    type="Plot"          >PlotRawdata</Output>
  </PostProcess>
</Steps>

```

Input file name: time_dep_relational.xml

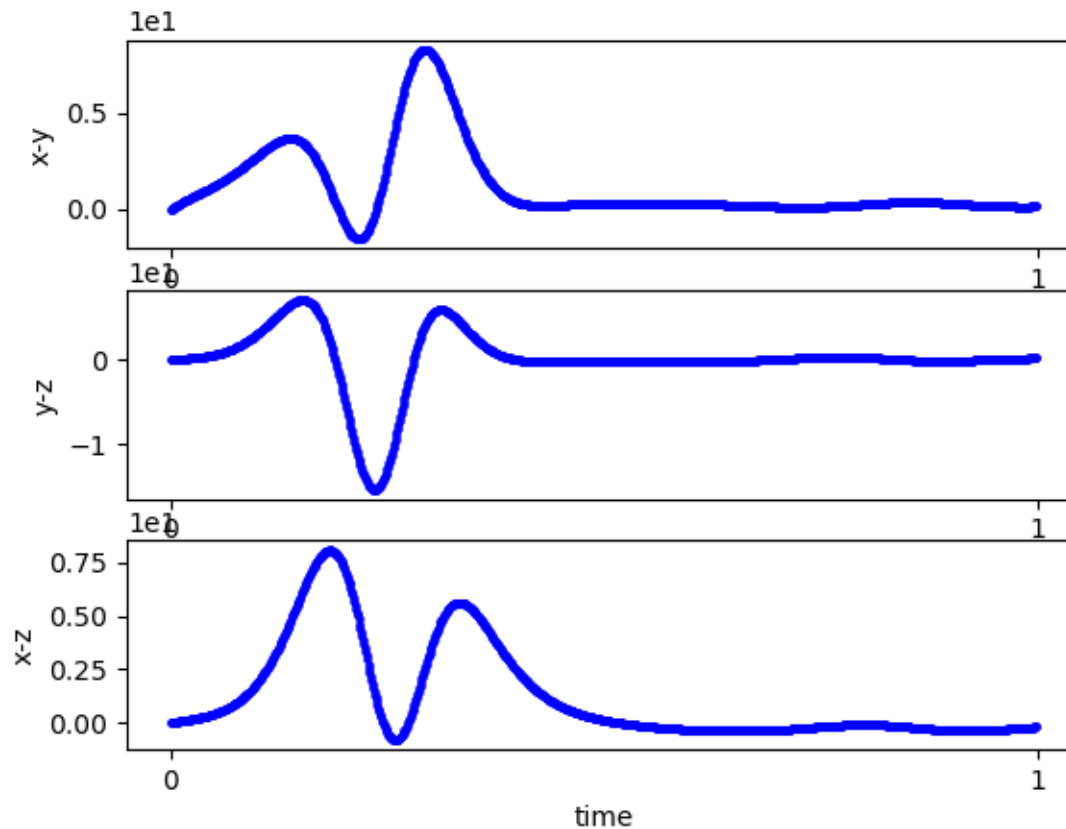
RAVEN Example 2: Time-Dep. Basic Statistics

Pearson



RAVEN Example 2: Time-Dep. Basic Statistics

Covariance



Input file name: time_dep_relational.xml

RAVEN Example 2: Time-Dep. Basic Statistics

Questions?