Introduction

LTPDA is a MATLAB toolbox that offers an object-oriented approach to data analysis. The user creates and modifies different types of user objects in order to build up a signal processing pipeline. Each user object keeps a full record of all processing steps it goes through. Because of this, the full processing history of each object can be viewed at any time, and used to reproduce the object, or the processing pipeline that created it.

Implementation

The toolbox is implemented as a set of classes programmed in standard MATLAB. There are a number of user classes which represent objects intended to be manipulated by the user. The methods of these user classes provide the user the ability to do:

- Signal-conditioning
- Spectral-analysis
- Curve-fitting and parameter estimation
- Pole/zero modelling
- State-space modelling
- Dimensional analysis
- Digital filtering
- ... and much more.

Due to the object-oriented design of the toolbox, script writing is vastly simplified and typically only requires the application of class methods to the objects created by the user. For example, the following code extract creates a synthetic time-series signal and then computes and plots an estimate of the power spectral density:

```matlab
a = ao(plist('waveform', 'sine wave', 'fs', 10, 'nsecs', 100));
a.psd
a.iplot
```

Running these commands yields the plot shown here:

As well as the user objects, there are many other user object classes implemented which provide the infrastructure used by the user classes.

Centralised Data Access

In order to provide concurrent storage and retrieval of LTPDA user objects, the toolbox has a built in client that can talk to an LTPDA server. The server is a database system that stores the LTPDA objects and a wealth of meta-data which can be used to search for specific objects.

User Objects

The user objects form the core of the toolbox’s capabilities. The following classes of user object are implemented:

<table>
<thead>
<tr>
<th>class</th>
<th>description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ao</td>
<td>Analysis objects containing time-series, frequency-series, x-y data series, vectors or matrices</td>
</tr>
<tr>
<td>plist</td>
<td>Parameter lists for configuring algorithms.</td>
</tr>
<tr>
<td>ssm</td>
<td>State-space model objects</td>
</tr>
<tr>
<td>mfr</td>
<td>FIR digital filter representation</td>
</tr>
<tr>
<td>pzm</td>
<td>Transfer function representation as S-domain poles and zeros</td>
</tr>
<tr>
<td>rational</td>
<td>Transfer function represented as a rational function of S</td>
</tr>
<tr>
<td>parfrac</td>
<td>Partial fraction representation of transfer functions</td>
</tr>
<tr>
<td>linspace</td>
<td>Representation of an interval of time</td>
</tr>
</tbody>
</table>

Each user object can be saved and loaded from disk in an XML format, and submitted and retrieved to/from and LTPDA repository.