Physiome Model Repository

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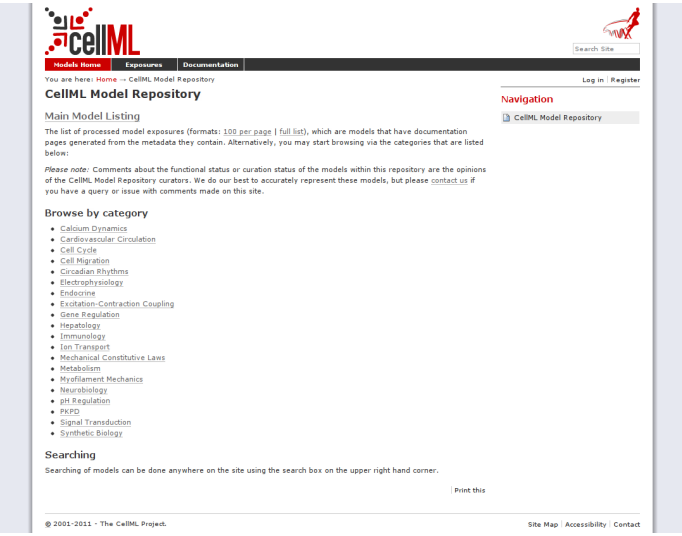
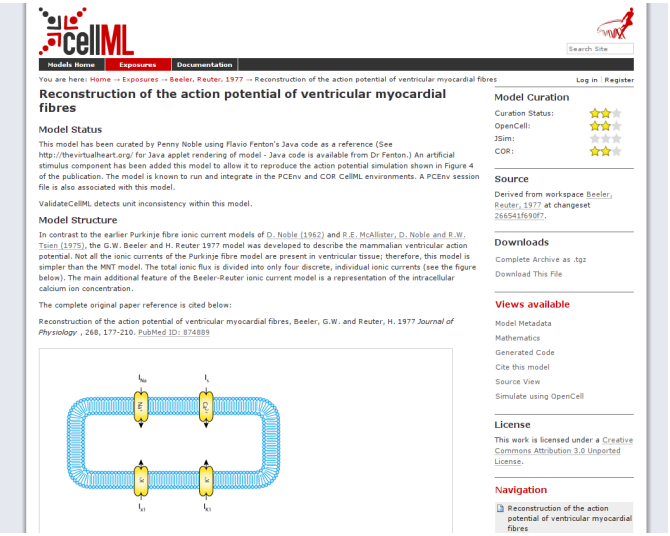
Te Whare Wānanga o Tāmaki Makaurau

PMR is...

- Used to power the CellML model repository.
- Able to support the presentation of FieldML through the ZINC plugin.
- The Physiome Model Repository.





Features Overview

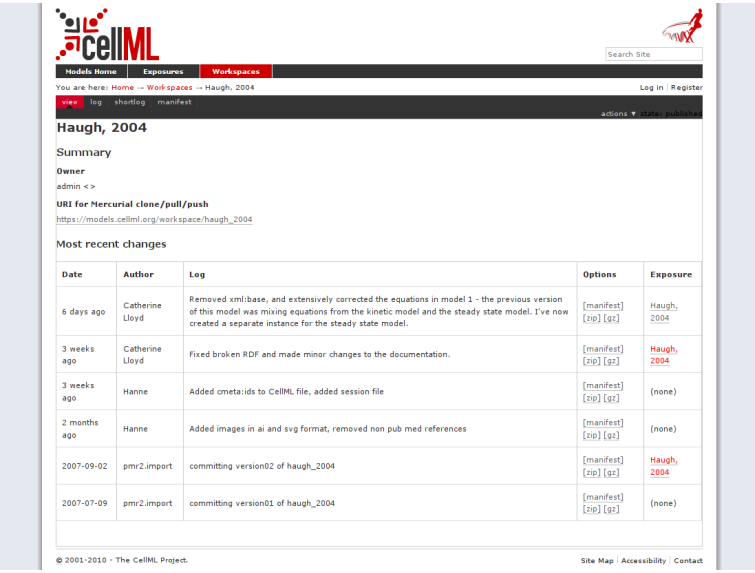
- Version controlled storage of models
  - They are encapsulated as **Workspaces**.
- Content management system (CMS) for presentation of models.
  - The set of presentation views is known as **Exposures**.
- User access control to models.
  - Provided as a standard Plone CMS feature
- Foundation for a plug-in system, to allow plug-ins to be built with relative ease.
- All presentation views and storage backends are implemented as plug-ins, and is enabled on-demand.

Version control system

- An original goal of the CellML Model Repository was to allow the tracking of changes between versions.
- Need user friendly client
  - Such as Tortoise(SVN|Hg) for Windows.
- Avoid single point of failure.
  - Distributed version control system (DVCS).
- Mercurial was chosen at first.
- Git support under development.
  - Version of large files using git-annex (tentatively).

Workspaces

- Every users within the system can create workspaces.
- Different policies for avoiding id clashes can be used.
- Can be forked/cloned at will, like other DVCS providers.

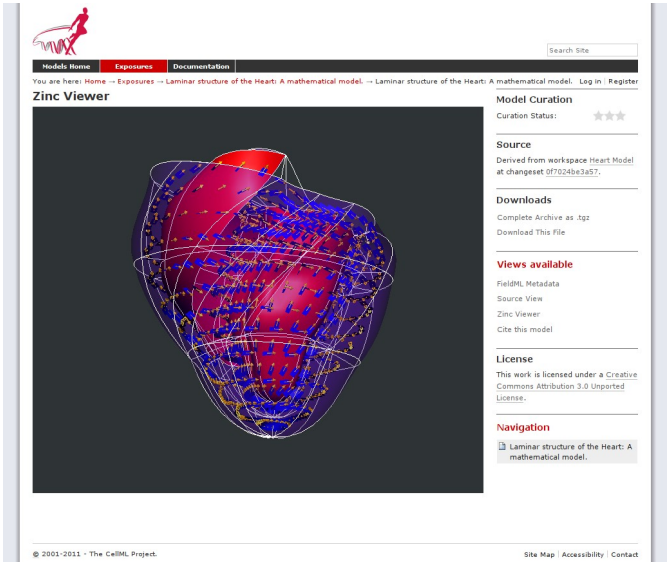


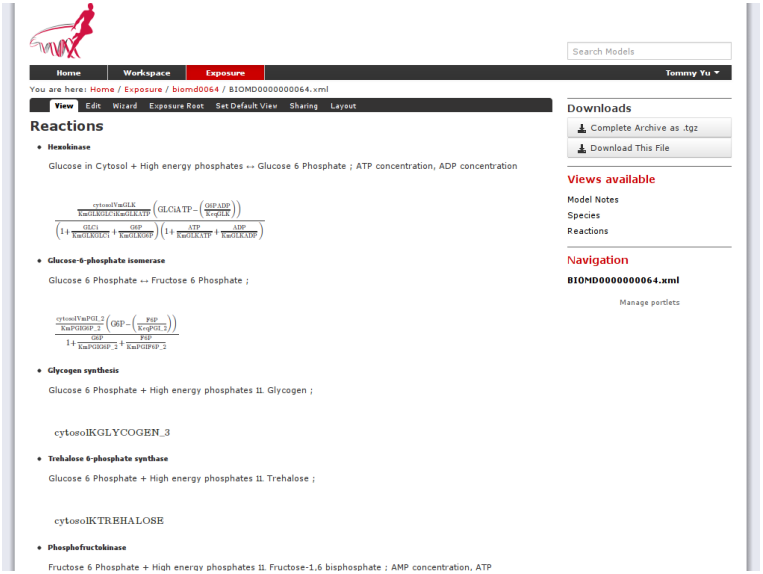
Presentation of models and data

- Define models as content to present to all users.
- Must be fully extensible;
  - Need to support all model formats developed as part of the Physiome Project.
- Also need user access control;
  - E.g. enable prepublication reviewer access.
- All are traits of content management system.
  - We decided on Zope/Plone due to existing usage of this system and its feature-completeness.

Exposures, presentational plugins

- Examples of extensibility includes:
  - CellML Code Generation with syntax highlighting.
  - Zinx viewer
  - A demo plugin for displaying basic SBML info.





More presentation goodness

- Cross platform math rendering with the aid of CellML API and MathJAX.
- Ability to provide limited customizable views for specific file types from within workspaces, such as images being displayed and structured text formats are rendered.

Component: INa

$$\mathrm{GNa} = \begin{cases} 11.5 \text{ if tissue} = 0 \\ 411.5 \text{ otherwise} \end{cases}$$

$$\mathrm{gNa} = \mathrm{GNa} mmmHJ$$

$$\mathrm{INa} = \mathrm{gNa}(V - \mathrm{ENa})$$

$$\mathrm{ah} = \begin{cases} 0 \text{ if } V \geq -40 \\ 0.135 e^{\frac{80+V}{-6.8}} \text{ otherwise} \end{cases}$$

$$\mathrm{aj} = \begin{cases} 0 \text{ if } V \geq -40 \\ \frac{\left((-1.2714\mathrm{e}5) e^{0.2444V} - \left(3.474\mathrm{e}{-5} e^{(-0.04391)V}\right)\right) 1(V+37.78)}{1+e^{0.311(V+79.23)}} \text{ otherwise} \end{cases}$$

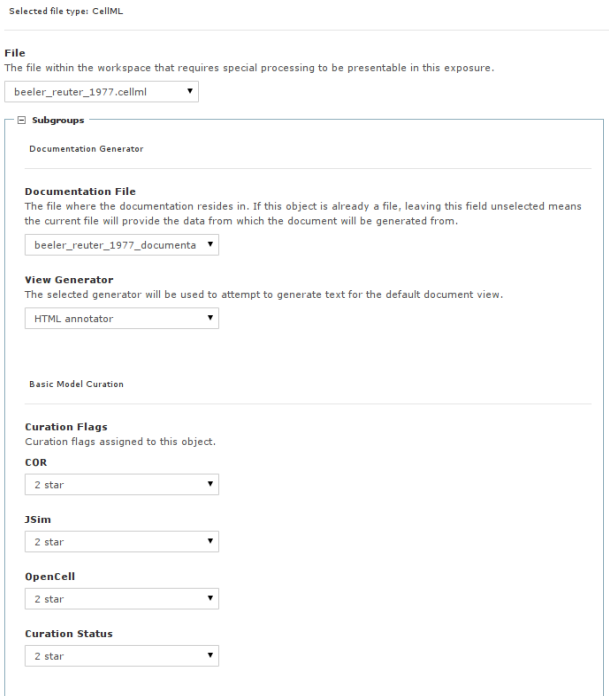
$$\mathrm{bh} = \begin{cases} \frac{1}{0.13\left(1+e^{\frac{V+10.66}{-11.1}}\right)} \text{ if } V \geq -40 \\ 3.56 e^{0.079V} + 3.1\,\mathrm{e}\,5 e^{0.35V} \text{ otherwise} \end{cases}$$

$$\mathrm{bj} = \begin{cases} \frac{0.3 e^{(-2.535\mathrm{e}{-7})V}}{1+e^{(-0.1)(V+32)}} \text{ if } V \geq -40 \\ \frac{0.1212 e^{(-0.01052)V}}{1+e^{(-0.1378)(V+40.14)}} \text{ otherwise} \end{cases}$$

$$\mathrm{am} = \frac{0.321(V+47.13)}{1-\left(e^{(-0.1)(V+47.13)}\right)}$$

Recently implemented features

- Wizard for creating Exposures (i.e. presentation views).
- Web services that adheres to REST/Hypermedia principals.



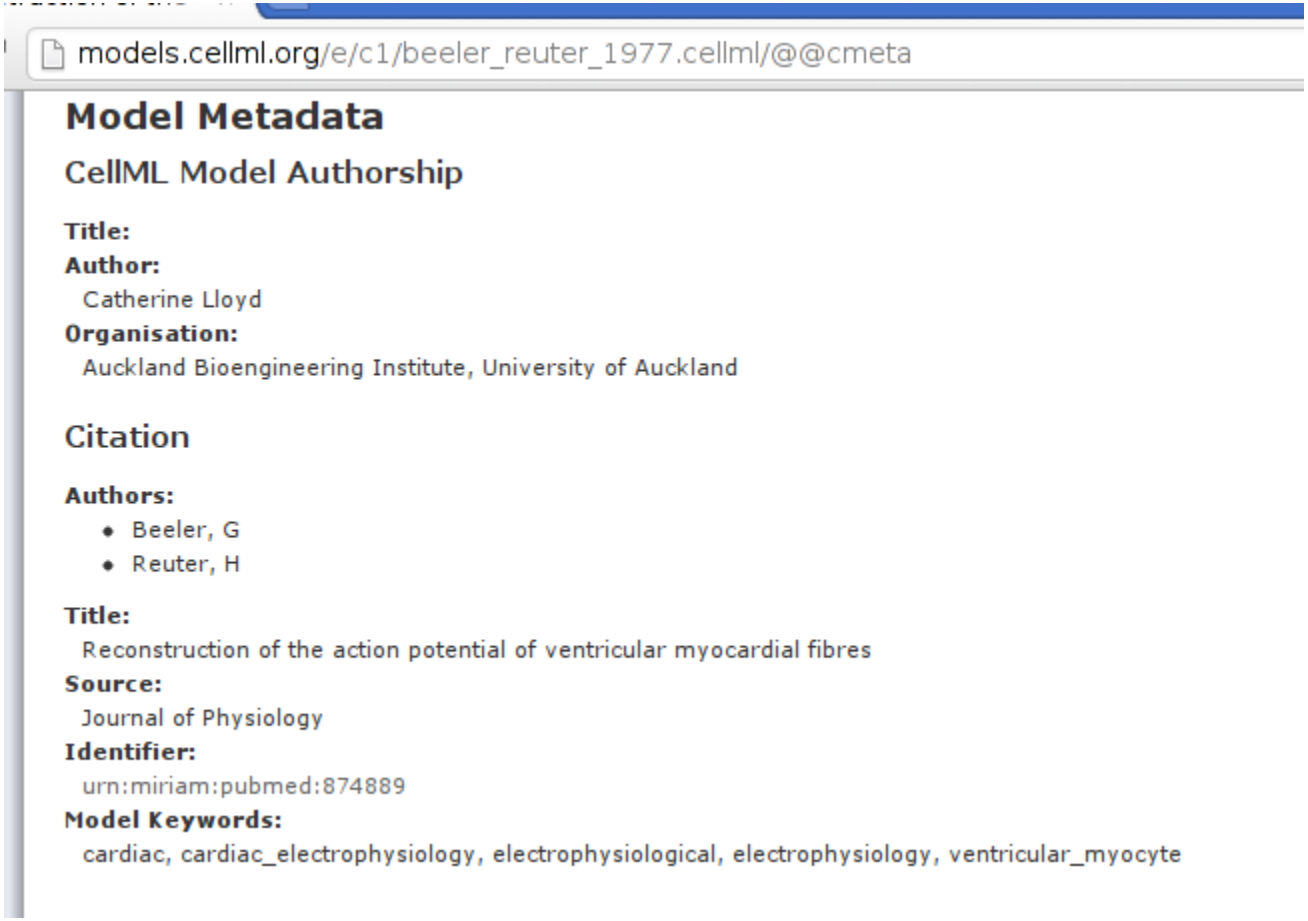
Import/Export (synchronization)

- Import raw models from external repositories
  - Allow users to host their models on other repositories, like bitbucket (or github once we get git support).
  - Providing a simple way to import models into PMR as an incentive for keeping models in DVCS.
- Export/import of Exposure structures
  - Allow the work that might have been done on another instance of PMR2 be imported into the main instance seamlessly.

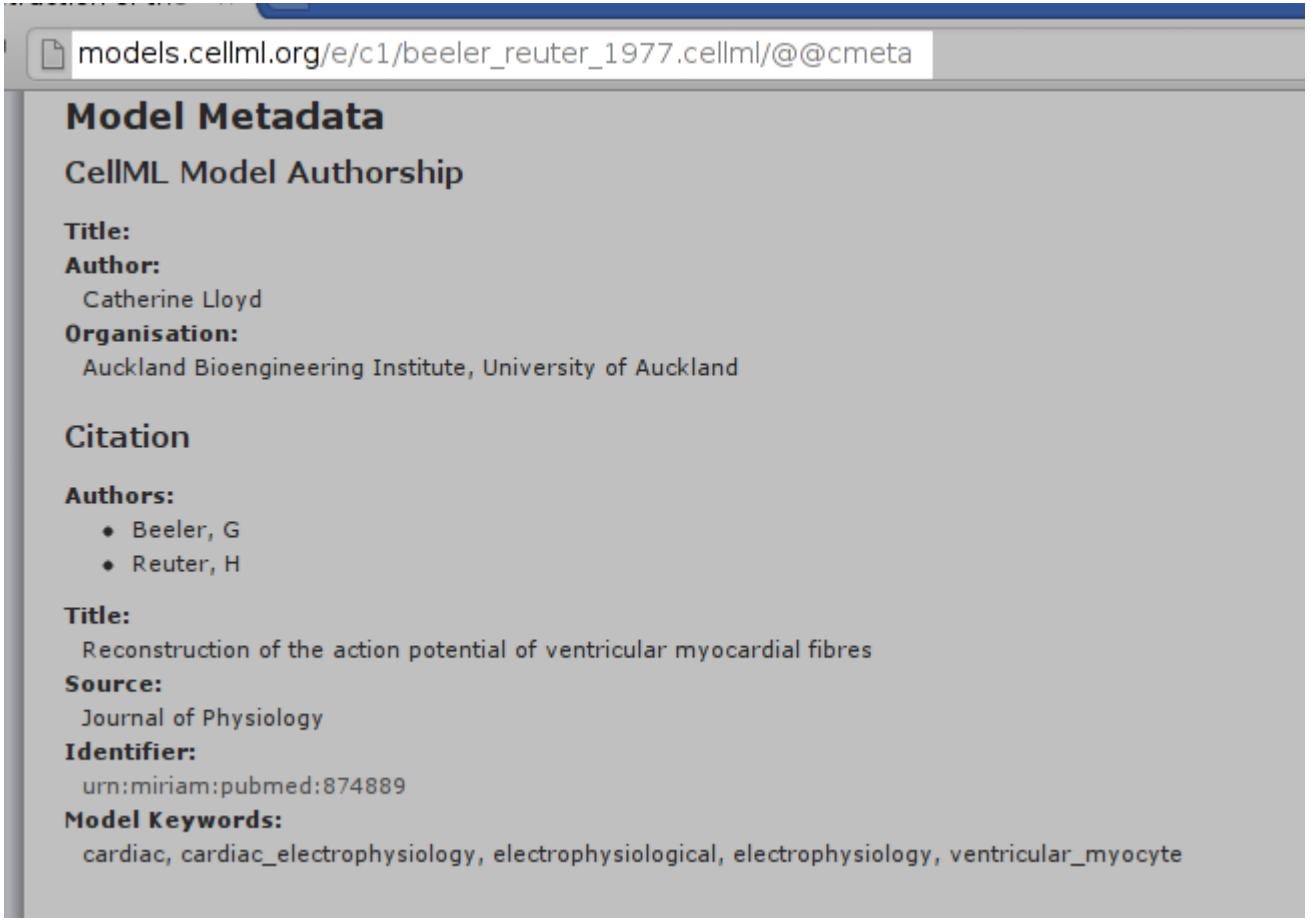
Web services

- Adhere to REST/Hypermedia principals
  - Reliance on a single canonical URI per resource; the web service is simply a matter of specifying the accepted content type.
- Nearly all resources have some form JSON representations for them.
- OAuth 1.0 for authorizing third-party client access to private user content.

Web services



Web services



Web services

```
>>> import requests
>>> r = requests.get(
...   'http://models.cellml.org/e/c1/beeler_reuter_1977.cellml/@@cmeta')
>>> len(r.content)
14064
```

Web services

```
>>> from pprint import pprint
>>> import requests
>>> r = requests.get(
...   'http://models.cellml.org/e/c1/beeler_reuter_1977.cellml/@@cmeta',
...   headers={'Accept': 'application/vnd.physiome.pmr2.json.0'})
>>> len(r.content)
623
>>> r.json()['citation_title']
u'Reconstruction of the action potential of ventricular myocardial
fibres'
>>> pprint(r.json()['keywords'])
[[u'#beeler_reuter_1977', u'cardiac electrophysiology'],
 [u'#beeler_reuter_1977', u'cardiac'],
 [u'#beeler_reuter_1977', u'electrophysiology'],
 [u'#beeler_reuter_1977', u'electrophysiological'],
 [u'#beeler_reuter_1977', u'ventricular myocyte']]
```

Web services

```
GET /pmrdemo/workspace HTTP/1.1
Host: localhost

HTTP/1.1 200 OK
...
Content-Length: 13730
Content-Type: text/html;charset=utf-8

<!DOCTYPE html>
...
        <a
href="http://localhost/pmrdemo/workspace/beeler_reuter_1977"
class="state-published contenttype-workspace" title="">
            <span>Beeler, Reuter, 1977</span>
        </a>
```

Web services

```
GET /pmrdemo/workspace HTTP/1.1
Host: localhost
Accept: application/vnd.physiome.pmr2.json.0

HTTP/1.1 200 OK
...
Content-Length: 192
Content-Type: application/vnd.physiome.pmr2.json.0

[{"target":
"http://localhost/pmrdemo/workspace/beeler_reuter_1977",
"title": "Beeler, Reuter, 1977"}, {"target":
"http://localhost/pmrdemo/workspace/HH-sbml", "title": "Hodgkin
Huxley SBML"}]
```

Future

- Work in progress
  - Integration with RICORDO metadata framework.
  - Or any other external services to index models in PMR in a more comprehensive manner, which in turn allow PMR to leverage their search services on that index.

Finally

- Facilitates collaborative model development in a generic, service agnostic manner.
- Provide a foundation to build services to store, access and interact with models.
- Link with external web-services to provide semantic reasoning against metadata across models over all the available resources, so that the most appropriate models be made known to users.

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