



PMR2: supporting collaborative, reproducible, and discoverable science

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Abstract

Background: PMR2 is the software framework supporting the Physiome Project Repository hosted at: <https://models.physiomeproject.org>. All content of the repository is stored in version-controlled workspaces and specific revisions of a workspace can be exposed with a persistent URL and customisable presentation via the web interface. Access control is a key part of PMR2 and users of the repository are able to choose to keep their data private, shared with specific collaborators, or public.

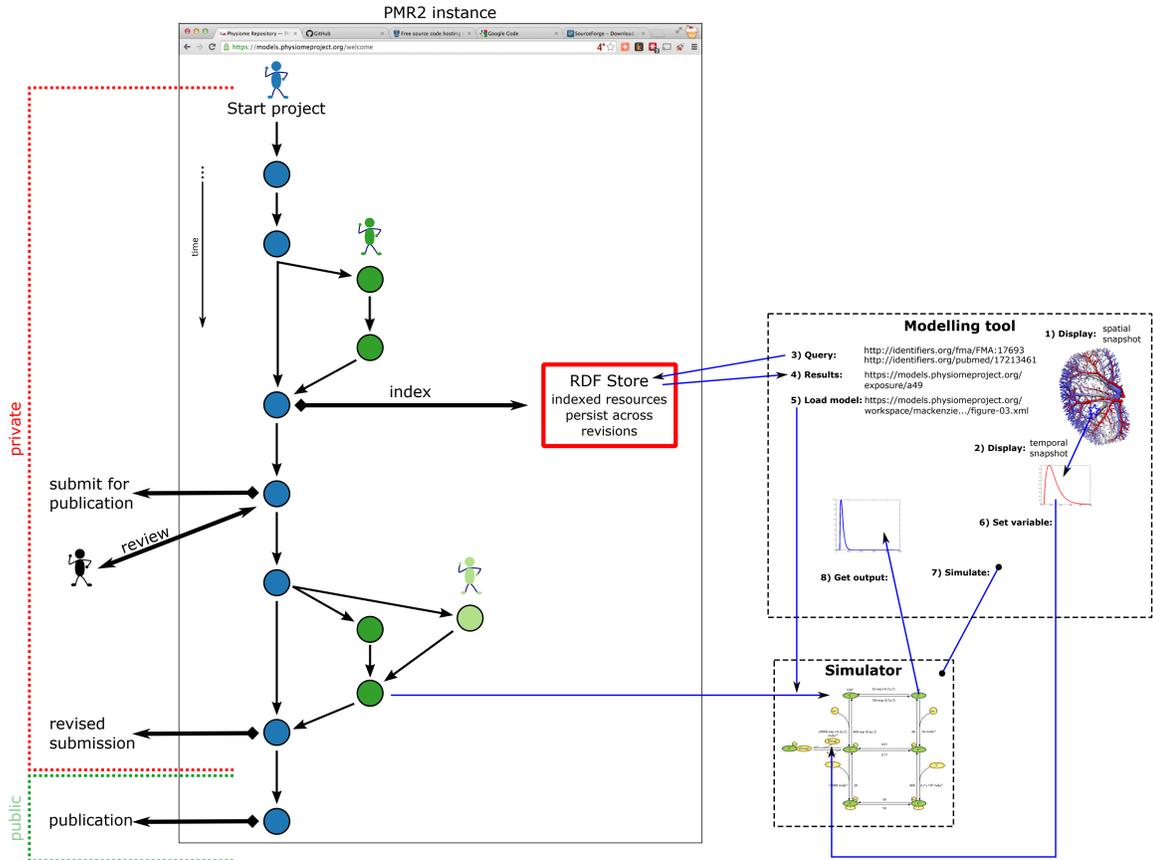
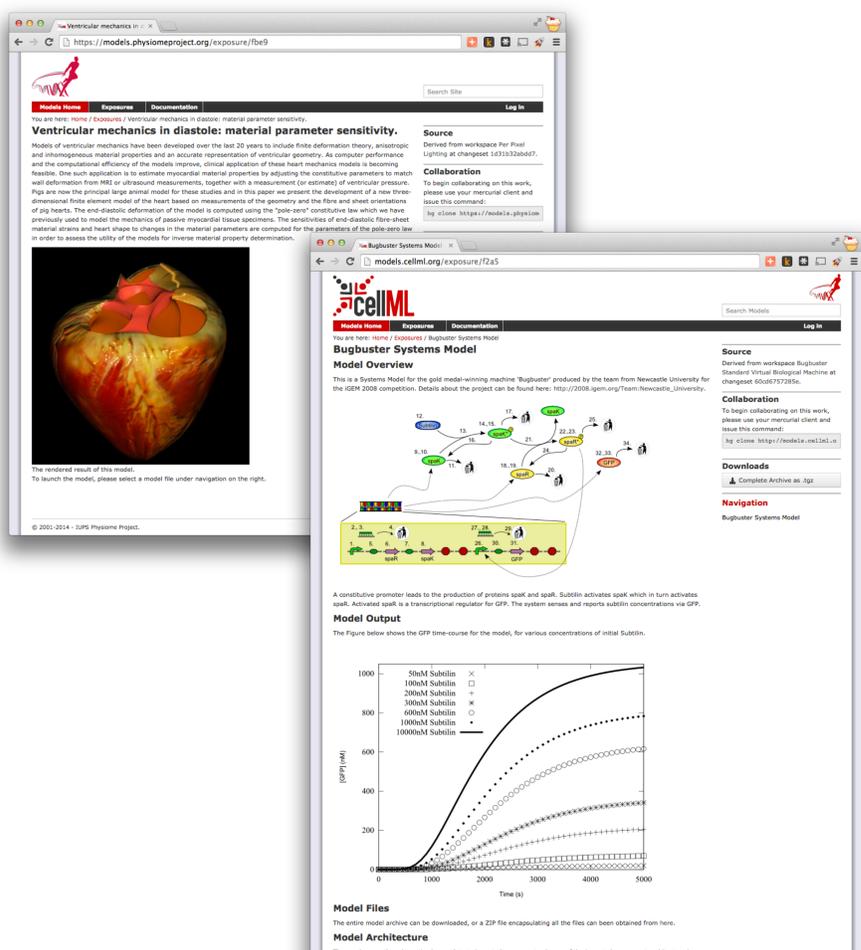
Method: Recent developments in the PMR2 software stack have seen the inclusion of semantic web technologies and the provision of new web services that are able to leverage the semantic content of the repository to enhance the ability of application developers to discover, access, and modify data contained in the repository.

Results: Users of the repository are now able to flag specific items in their workspaces as annotations to be indexed in the semantic knowledgebase of the repository. When new versions of these items are pushed into the workspace, the knowledgebase is automatically updated. Application developers are able to make use of PMR2 web services to access this semantic knowledgebase to discover data matching their requirements.

Conclusion: PMR2 provides a framework encouraging the collaborative development and evolution of mathematical models and associated data. Recent innovation in the PMR2 framework has significantly improved the ability of application developers and repository users to discover content that meets their requirements.

Exposure plug-ins for web presentation

Examples illustrating the current FieldML (left) and CellML (right) rendering plug-ins utilised in the web interface of PMR2. The preliminary FieldML rendering makes use of the FieldML precursor data format and the zinc firefox plugin (cmis.org/cmgui/zinc) to provide an interactive three-dimensional viewer for the FieldML model. This is currently being migrated to a WebGL model viewer. There is also an HTML-based plug-in which allows user defined workspace views to be presented to repository users.



Collaboration and reproducibility

PMR2 makes use of versioned workspaces to store and manage data. Each filled circle in the figure above represents a different version of the workspace and each colour represents changes made by a different person. Encapsulating an entire piece of work in a workspace makes it easy to share not just the current state of the work, but the entire provenance record of how the current state evolved over time. For example, when submitting a paper for review, the reviewer is able to access the exact version used in creating the submission in order to both aid their review of the work and enhance their feedback. Making use of appropriate standards to encode the data contained in the workspace ensures that users are able to make use of that data and reproduce the expected outputs.

PMR2 provides access control on the level of workspaces, so work can be kept private as required yet shared with team members and potentially anonymous reviewers. The use of a standard versioning system makes it trivial to synchronize a workspace across many different cloud based platforms. For example, the Physiome Project Repository instance of PMR2 makes use of the Mercurial version control system, so users are able to synchronize their workspaces across Bitbucket, Google Code, or SourceForge depending on their particular requirements or familiarity.

Discoverable science

The right part of the above figure is an illustrative example of the interaction between some generic tools and the PMR2 web services. Using standard identifiers (in this example the FMA term for the renal proximal tubule and a PubMed ID for a specific paper), the modelling tool is able to query the repository's knowledgebase and discover any relevant models for the task at hand. The provenance records and other relevant data can then be presented to the user to help them make an informed decision on not only which model they would like to use but also the specific revision of that model. The modelling tool can then instruct the simulation tool to load the chosen model. The user of the modelling tool can then configure the model as required and perform simulations and present the results to the user.



Acknowledgements

