Releasing Scientific Software in GitHub: A Case Study on SWMM2PEST

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Storm Water Management Model (SWMM)

Partial statistics on using SWMM for research in 2018 based on Google Scholar

https://www.epa.gov/water-research/storm-water-management-model-swmm
The scientific software we are releasing

SWMM2PEST

An integration of the SWMM and PEST scientific programs

Dynamic rainfall-runoff simulation model
Version 5.1.013 was released in 2018
About 45,500 LoC

Model-Independent Parameter Estimation and Uncertainty Analysis
Version 15 was released in 2018
About 210,000 LoC
Characteristics of scientific software

• Highly specialized: 1,000 to 100,000 LoC
• People: A few scientists-developers

Scientists often develop their own software for research for a relatively small user set, which may not be well documented and debugged for general use of others.
Release engineering

• Help accelerate software development and delivery
• Increase customer trust and satisfaction
• Provide faster feedback to developers
• Enhance the communication of integration systems
• Improve software quality
• ...

How to release **scientific software** by applying release engineering
Metamorphic testing

Alleviate the oracle problem

Published as Technical Report HUST-CS98-01, Department of Computer Science
The Hong Kong University of Science and Technology, 1998.

Metamorphic Testing:
A New Approach for Generating Next Test Cases
T. Y. Chen, S. C. Cheung, S. M. Yiu
# Metamorphic testing on SWMM2PEST

### Hierarchical Metamorphic Relations for Testing Scientific Software

<table>
<thead>
<tr>
<th>Xuanyi Lin</th>
<th>Michelle Simon</th>
<th>Nan Niu</th>
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</table>

## Exploratory Metamorphic Testing for Scientific Software

### Data Summary

<table>
<thead>
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<th>Unchanged</th>
<th>Increased</th>
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</table>

### Our ongoing work

- Bug: 1
- Mismatch: 1
- Constraint: 1 and 2
SWMM2PEST 1.0 to 2.0

**Changes**

<table>
<thead>
<tr>
<th>Added &amp; modified lines (source code)</th>
<th>Deleted lines (source code)</th>
<th>Added &amp; modified UI files</th>
<th>Deleted UI files</th>
</tr>
</thead>
<tbody>
<tr>
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<td>696</td>
<td>5</td>
<td>2</td>
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</tbody>
</table>

- Metamorphic testing
- Bugs fixed
- Restructured
- New features added

**SWMM2PEST 1.0**

Developed by Suraj Kamble
Python 3.5.4&PyQt 5
About 3,300 LoC

**SWMM2PEST 2.0**

Developed by Xuanyi Lin
Python 3.5.4&PyQt 5
About 3,200 LoC
GitHub-driven release process

Release workflow

SWMM2PEST

Bugs → discover → fix → Tests

Features → add → continuous release

Feedback → Users

GitHub

- README file
- Source code
- Application
- Release note

access

GitHub-driven release process
Releasing in GitHub

How to run

A. In PyCharm
   1. Run MainFrame.py
   2. Run as Windows application

B. Download SWMM2PEST
C. Unzip the file
D. Run SWMM2PEST

How to use

A. Input File Selection
   1. Provide SWMM input file
   2. Click "Start"

Caveats

1. Do not include the parameter with a value of 0 to do the calibrator
2. The folder path of the input file cannot contain spaces.
3. Same parameters in SWMM input file and observation file must be
4. Make sure the observation data format is the same format as the output contain date (mm/dd/yyyy), time (hh:mm:ss) and value, e.g. 01/30/2018

Project status

SWMM2PEST 2.0: June 2018
SWMM2PEST: August 2017

Contributing

Everyone is welcome to contribute to this project.

Categorizing the Content of GitHub README Files

Gede Artha Azriadi Prana¹, Christoph Treude², Ferdian Thung¹, Thushari Atapattu², David Lo¹
Releasing in GitHub

Source Code

Release software
Changes between versions

<table>
<thead>
<tr>
<th>SWMM2PEST</th>
<th>SWMM2PEST 1.0</th>
<th>SWMM2PEST 2.0</th>
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<td>SWMM PEST</td>
<td>5.1.10</td>
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<tr>
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<td>13.3</td>
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SWMM 5.1.10

SWMM 5.1.13
Improvements as requirements change

SWMM2PEST 1.0 UI

SWMM2PEST 2.0 UI
Insights

• Release as *required*
• *Connector* versus *connectee* release
• Release to help automated *testing*

Future work

• Investigate other repositories
• Continuous release with more comprehensive user feedback and other developers' opinions
Thank you

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