Review of open source tools for PV modeling

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Goals for this talk

• Promote the use of open source software in the PV modeling community

• Summarize the state of open source for PV modeling

• Stimulate discussion of how to support open source PV modeling projects in the future
Why use open source PV tools?

• *The Scientific Paper is Obsolete* (The Atlantic, April 2018)

• Encourages reproducibility and replicability in science

• Open source analyses encourage transparency and collaboration

• Project financing soft costs could be reduced through transparent, vetted algorithms

• More people looking at code, using it in different situations may yield more robust tools

• Modify the code to make it work better for you
| Name                  | Purpose                                                                 | Years Developed | Documentation Website             | Development Website               | Primary Languages | License       |
|----------------------|--------------------------------------------------------------------------|-----------------|-----------------------------------|-----------------------------------|-------------------|---------------|
| PVLib Matlab         | General purpose PV modeling                                              | 2012 - *        | pvpmc.sandia.gov                  | github.com/sandialabs/MATLAB_PV_LIB Matlab | Matlab            | BSD 3        |
| PVLib Python         | General purpose PV modeling                                              | 2013 - *        | pvlib-python.readthedocs.io       | github.com/pvlib/pvlib-python     | Python            | BSD 3        |
| System Advisory Model| Desktop app for PV, wind, CSP modeling, financial                        | 2013 - *        | sam.nrel.gov                      | github.com/NREL/SAM                | C++               | Mixed        |
| ssc                  | Compute modules for SAM                                                  | 2010 - *        | sam.nrel.gov                      | github.com/nrel/ssc                | C, C++            | Mixed        |
| rdtools              | PV degradation                                                           | 2017 - *        | github.com/NREL/rdtools           | github.com/NREL/rdtools            | Python            | MIT/GPL 3    |
| PVFree               | API for obtaining PV modeling parameters                                 | 2015 - *        | pvfree.herokuapp.com              | github.com/SunPower/pvfree        | Python            | Unlicensed    |
| SolarUtils           | Python wrappers of C solar position and spectral decomposition            | 2016            | github.com/SunPower/SolarUtils    | github.com/SunPower/SolarUtils    | Python            | BSD 3        |
| Pecos                | Performance monitoring                                                   | 2016 - *        | pecos.readthedocs.io              | github.com/sandialabs/pecos       | Python            | BSD 3        |
| Solpy                | General purpose PV modeling                                              | 2011-2015       | solpy.readthedocs.io              | github.com/nrcharles/solpy        | Python            | LGPL 2.1     |
| PVMismatch           | IV curve calculator for mismatched cells                                  | 2012 - *        | sunpower.github.io/PVMismatch/    | github.com/SunPower/PVMismatch    | Python            | BSD 3        |
| photovoltaic         | General purpose PV modeling                                              | 2017 - *        | github.com/trautsned/photovoltaic | github.com/trautsned/photovoltaic | Python            | GPL 3        |
| feedinlib            | PV timeseries modeling                                                   | 2015 - *        | github.com/oemof/feedinlib        | github.com/oemof/feedinlib        | Python            | GPL 3        |
| CASSYS               | PV system modeling                                                       | 2015 - *        | github.com/CanadianSolar/CASSYS   | github.com/CanadianSolar/CASSYS   | Excel, C#         | BSD 3        |
Two development models

I giveth thee mostly-finished software that I’ve been toiling on in private

- SAM/ssc
- PVLIB Matlab
- Rdtools

Let’s make some software in the open, warts and all

- PVLib Python
- PVMismatch
- feedinlib

My recommendation: choose what works for you, but don’t be afraid to develop openly
Licenses

• Permissive: BSD 3, MIT
• Restrictive (copy left): GPL 3, LGPL 2.1
• Dual: Mixed GPL 3/MIT
• Unlicensed

• I urge you to:
  • Spend 15+ minutes reading about licenses (multiple times)
  • Choose the license consistent with what you want – not your lawyers
  • License all of your code (unlicensed != public domain)
Funding

SHOW ME THE MONEY!!!!!!!
## Funding

### Source of funds

| Kind of funds | Public                     | Private                               |
|---------------|---------------------------|---------------------------------------|
| **Direct**    | DOE support PVLib Matlab & SAM | Southern/EPRI funded UA to add solar forecasts to PVLib Python |
|               |                           |                                       |
| **Indirect**  | DOE supports this workshop, which helps all of us. | SunPower, First Solar, DNV-GL, IMS, Sunshine Analytics... engineers contribute to open source software |
|               |                           |                                       |

There are many ways you can support open source software!
Funding

• *Show me the impact!*  – person/group with the money

• Hard to trace impact

• Harder still to quantify impact
Funding

• Easy way for SETO to support open source:
  • FOA can require that software be released as open source
  • At least encourage it in the data management plan!
Community

- Strong open source projects have strong user and developer communities

- Communities need help to grow and remain healthy
  - The PVPMC workshop is great for that
  - What else can we do?

- Who decides when code is ready to be merged into a package?

- Most people behave professionally, but not all
  - Formal codes of conduct may help
Resources

• Version control, GitHub, package management stymies people – we will help you!

• But my code is no good – we will help you!

• Let’s learn from others:
  • SciPy Conference
  • AMS Python Symposium
  • opensource.org
  • opensource.guide
  • Roads and Bridges, N. Eghbal
  • contributor-covenant.org

https://stackoverflow.com/questions/15651576/github-team-usage
Conclusions

• It’s wonderful that we can now have an open source PV review talk

• We should talk more about project scope, ambition, and collaboration, but...

• It’s also ok for open source projects to compete a little bit

• “Funding” for open source PV tools is complicated and evolving

• Future success or failure is determined by everyone in this room
  • Contribute as you can
  • Be respectful above all else

See Holmgren et. al., PVSC 2018 for more