The Pencil Code Newsletter

Issue 2021/1

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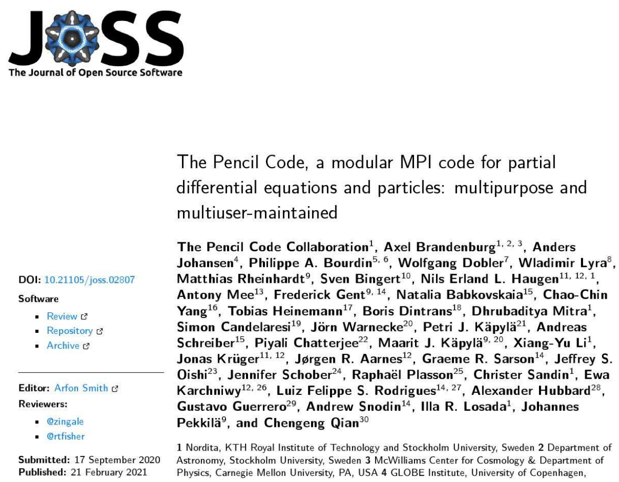
Contents

1 Pencil Code office hours

As reported in our previous newsletter 2020/3, we had our first Pencil Code office hours on 8 January this year. This event brought experts and newcomers together and was regarded as a constructive means of spreading knowledge about scientific computing in general and using the Pencil Code in particular. It was decided to continue this activity on a monthly basis. Since then we had office hours on 12 February and 12 March. The next one, on the second Friday of April, is on April 9. The new time will be 15:00 CEST. The address is `https://stockholmuniversity.zoom.us/j/6415995185`. See you then.

2 Pencil Code User Meeting

The 17th Pencil Code User Meeting (PCUM) will take place in the week of May 17–21 2021. The meeting is organized by Jennifer Schober and will be held virtually via zoom. More information on the meeting, including the link to the registration form, can be found here: `https://www.epfl.ch/labs/lastro/meetings/pcum2021/`. Registration closes on April 25th.



The Journal of Open Source Software

The Pencil Code, a modular MPI code for partial differential equations and particles: multipurpose and multiuser-maintained

The Pencil Code Collaboration[1], Axel Brandenburg[1, 2, 3], Anders Johansen[4], Philippe A. Bourdin[5, 6], Wolfgang Dobler[7], Wladimir Lyra[8], Matthias Rheinhardt[9], Sven Bingert[10], Nils Erland L. Haugen[11, 12, 1], Antony Mee[13], Frederick Gent[9, 14], Natalia Babkovskaia[15], Chao-Chin Yang[16], Tobias Heinemann[17], Boris Dintrans[18], Dhrubaditya Mitra[1], Simon Candelaresi[19], Jörn Warnecke[20], Petri J. Käpylä[21], Andreas Schreiber[15], Piyali Chatterjee[22], Maarit J. Käpylä[9, 20], Xiang-Yu Li[1], Jonas Krüger[11, 12], Jørgen R. Aarnes[12], Graeme R. Sarson[14], Jeffrey S. Oishi[23], Jennifer Schober[24], Raphaël Plasson[25], Christer Sandin[1], Ewa Karchniwy[12, 26], Luiz Felippe S. Rodrigues[14, 27], Alexander Hubbard[28], Gustavo Guerrero[29], Andrew Snodin[14], Illa R. Losada[1], Johannes Pekkilä[9], and Chengeng Qian[30]

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Figure 1: Visit JOSS yourself to check out the links.

3 JOSS paper

The JOSS paper is now published as

Pencil Code Collaboration: 2021, "The Pencil Code, a modular MPI code for partial differential equations and particles: multipurpose and multiuser-maintained," *J. Open Source Software* **6**, 2807

4 Changes of defaults

As already mentioned in the Newsletter 2020/2, the Pencil Code comes with a lot of default settings, and many of those are set to what was of interest when a particular module was developed. Sahel Dey and Piyali Chatterjee (both from Bengaluru [=Bangalore]) alerted us to a change and wrote us the following:

We report a change to the default value of a logical flag in the module `temperature_ionization.f90` called `lviscosity_heat` which was in the past set to "false". This prevented viscous heating due to terms including shock heating from contributing to the RHS of the temperature equation. This may be undesirable for many users since in other energy modules this flag is by default set to "true". So, we have now changed the flag `lviscous_heat` to "true" by default in this module so that the temperature equation automatically includes viscous heating without the need to explicitly add the line `lviscous_heat=T` in `entropy_run_pars`. An example of an affected sample is `sample/solar_atmosphere_magnetic`.

The switch `lequatory` is now by default set to "true" for spherical coordinates as this is what can reasonably be expected. No samples are affected.

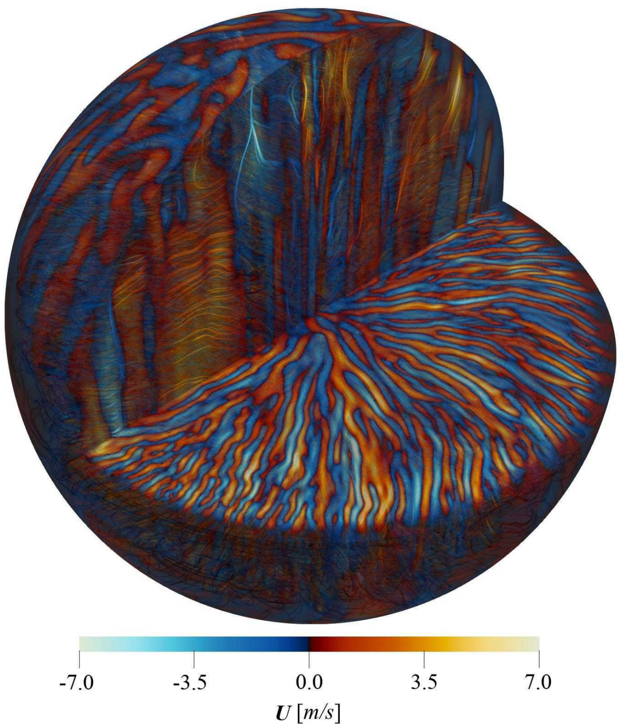

Figure 2: Snapshot from one of Petri's simulations; see `https://arxiv.org/abs/2012.01259` for the paper.

5 Letters to the editor

Petri Käpylä from Göttingen University reported about new dynamo simulations of fully convective stars with an updated version of the star-in-a-box model of Dobler et al. (2006). The new simulations show activity patterns similar to those in partially convective (solar-like) simulations as a function of rotation. Figure 2 shows the velocity field in the interior of a rapidly rotating 0.2 solar mass M5 dwarf.

The paper is in the arXiv (`https://arxiv.org/abs/2012.01259`) and contains responses to the first round of referee comments.

6 Code developments

6.1 Pencil Code goes Quantum

One of our users reported on a major success in porting the Pencil Code to the new quantum computer currently running in Thule (Qaanaaq) in Greenland (the newest system by D–Wave `https://www.dwavesys.com/quantum-computing`, see also `https://news.ycombinator.com/item?id=16797999` for a related link). Importantly, no significant changes where necessary, so all the standard applications including radiation transport and test-field methods still run smoothly. Full details will be described in the next newsletter.

6.2 Python for Pencil

Illa Losada informed us that there are now regular Python Pencil Code meetings, where improvements and new functionality are being discussed on the Python release of the code. There have already been three meetings and the next one is in April. We have also released a new email list to discuss issues solely related to Python post-processing of the Pencil Code. Join at `https://groups.google.com/g/pencil-code-python`.

Some of the topics of past meetings:

- We discussed the creation of automatic documentation using Sphinx. We will host this documentation in `https://readthedocs.org/`, using its integration with `https://github.com/`.

- In the wiki, we added a Python ↔ IDL guide for pencil postprocessing commands: `https://github.com/pencil-code/pencil-code/wiki/Pencil-IDL-to-Python-guide` .

6.3 Documentation

Illa Losada informed us that the Pencil Code manual (`https://github.com/pencil-code/website`) is currently being updated in the code repository: `https://github.com/pencil-code/website/blob/master/doc/manual.pdf`. The manual contains more than 300 pages, and explains in detail how to use, program and troubleshoot the code. We encourage continuous updates and additions to the manual, specially when adding new functionality to the code.

We are now working on improving and adding missing content in the manual, like a brief description of the `pencil-code/bin` functions. This is an important step that might even prevent situations like an undesirable merge branch, as explained in the Issue 2020/2, section 4 of this newsletter: A script `pc_git` is already included in the Pencil Code suite; it updates and merges with the git repository in the way suggested in that Newsletter and Wolfgang's "Git Best Practices" `http://pencil-code.nordita.org/doc/git-best-practises.pdf`. However, this script was not explained in previous versions of the manual, hence it might be difficult to know of its existence.

We have also updated Section K of the Appendix with information about the parameters needed when computing Fourier spectra with the code; see pages 180, 185, and 186 of the manual.

6.4 `pc_restrict`

This new helper script creates a new run directory for continuation of an existing run, but with restricted z extent, according to the range of z processors provided as parameter. A typical application is expected to be simulations in spherical geometry when one wants to look at localized phenomena like spots and vortices, but needs to avoid modeling the full 2π extent. The script invokes `pc_newrun`. `cparam.local`, `run.in` and `param.nml` are modified to render the new setup compile-and-run ready. `start.x` must not be executed. So far only implemented for `IO = io_dist`.

7 Papers since December

Since the last newsletter of December 1, some new papers have appeared on the arXiv, and others that were just preprints, have now been published. We list both, but not intermediate updates. We also list two Zenodo references that are now also on ADS.

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