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Climate of the Past
Discussions
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Interactive comment on "A new automated radiolarian image acquisition, stacking, processing, segmentation, and identification workflow" *by* Martin Tetard et al.

Anonymous Referee #3

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Structure/composition of the Paper

While the paper looks overwhelming due to the number of pages, the content is actually concise. The information written there is not too long nor short. The structure of the paper follows the usual format (introduction, methodology, results and discussion).

Methodology/approach to the Problem

Their workflow is a whole and complete system, which starts at image acquisition and ends at classification. The workflow hopes to ease the tedious task of identifying specimen from samples, which requires extensive and consistent taxonomic knowledge of the observer to correctly identifyÂăradiolarians. Research was done well, as it can be

Printer-friendly version

Discussion paper

seen that they have explained the steps in great detail (including the measurements).

As for the AI specific topic, they have used a usual Deep Learning approach. They have used ResNet and finetune it on their dataset. They have also included non-Radiolarian classes, which I believe provided an edge especially since they will be classifying things straight from the image acquisition (w/o humans to remove the non-Radiolarian particles). They have acquired a lot of samples, so they did not struggle that much on this part. Overall what I can see here is that the acquisition and segmentation of images are more tedious than the actual training and classification of Radiolarians.

For the purpose of training the Convolutional Neural Network (CNN) for identification ofÂăRadiolarians, they developed and released AutoRadio (AutomatedÂăRadiolarian). To encourage participation and contributions on adding more images to AutoRadio, they provided a very detailed protocol to standardize the way of obtaining images. Even the file for 3D printing Decanter, used to prepare the slides, is provided for everyone to use. The repository for Decanter also includes a video for the modified random settling protocol.

It is suggested that a section briefly discussing the convolutional neural network model should have been included. The approach fundamentally relies on the model and hence it is necessary to detail how it is applied so as to properly justify the solution for automated identification. As such, the section shall essentially include the following: CNN overview, model architecture, and training approach (transfer learning, loss, etc.)

A minor concern is that I noticed that the Random Settling Protocol, as discussed starting in line 95 and the video (https://www.youtube.com/watch?v=veRmKI4rGTo) differ in the series of steps taken for the preparation of theÂăradiolarianÂăslides. I recognize that some steps are possibly not filmed for brevity, and the difference in steps might suggest that what is written on paper may not be strictly followed. But the motivated reader who wishes to contribute and follow the protocol may feel confused at first. I also noticed that in the video, the sample taken only amounted to 0.1 mg, but in the protocol the recommended amount is 0.6 mg (line 130, step #15), as it corresponds to the best compromise to ensure that a sufficient number ofÂăradiolarianÂăspecimens are covered and at the same time the specimens are not crowded and not touching one another, as discussed in subsequent sections that overlaps might affect the ability of the workflow to identifyÂăradiolarians. What I thought is that in cases where the amount of samples is limited, taking at most 0.6 mg would be enough. All things taken, the inclusion of the video is very helpful.

Another concern is about imbalance in classes, which is actually common among Radiolarian studies. Reading on the documentation ofÂăParticleTrieur,Âăthe recommended number of images per class is 50 at minimum and preferably at least 200 images per class, which can be very difficult to achieve especially on rareÂăradiolarianÂăspecies. Commonly, data augmentation is performed to address the issue of class imbalance. But augmenting the data has to ensure that variations applied to the image still preserve the class/label after applying transformations. Hence, careful application of augmenting data must be ensured.ÂăParticleTrieurÂăalso makes use of weighted loss functions, which is another good way of handling class imbalance.

I agree that ideally, adding more data on rare species would improve the trained model so paper emphasizing the possibility of collaboration through adding more images to AutoRadio and detailing on how one can contribute is really a good step.

Discussion of the Results

They have used the usual metrics (Accuracy, Precision, Recall, Confusion Matrix). The results were good since image acquisition and segmentation methodology is already profound, their data is quite large (∼17k samples total), and they have reported an overall accuracy of 90%.

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