From: **Pasi Raumonen (TAU)** pasi.raumonen@tuni.fi
Subject: Re: Update on paper "Tree Species Classification Using Structural Features Derived From Terrestrial Laser Scanning"
Date: 9 June 2020 at 08:57
To: Kim Calders Kim.Calders@UGent.be

PR

Hi Kim,

Thank you for doing the extra effort for my benefit!

Here in turn is a code for you that reads those files of yours and converts the information into QSMs of the format (structure arrays) used in newer versions of TreeQSMs:

>> QSMs = convert_to_qsm_struct(folder);

The “folder” is the name string of the folder where the files are, for example in my case:
>> QSMs = convert_to_qsm_struct('/Users/raumonen/Downloads/qsm_opt/');

You can also add the species label with the census data of yours:
Import your “LINKED_tls_census.csv” it to Matlab's workspace as a “TABLE” (with a name e.g. “Census") and make sure the first column is a “string" and not a “number” so that the names/IDs are correct. Then define tree ids and species labels from the table:

>> ID = string(Census{:,1});
>> Species = string(Census{:,5});
>> QSMs = convert_to_qsm_struct('/Users/raumonen/Downloads/qsm_opt/',ID,Species);

Notice that now this code sort of treats each model as from a different tree: QSMs(1), QSMs(2), QSMs(3),… But we could modify the code so that each model from the same tree would be saved with the same row index: QSMs(i,1), QSMs(i,2), QSMs(i,3),…

Notice also that the code now assumes certain form for the file names to extract the tree id:s from them: `"xxxxx_xxxx_treeid-xxx-xxx..."`

I also added the QSMs into DropBox where you can find them:
https://www.dropbox.com/s/3rf6ghij7tft1w5/wytham_qsms.mat?dl=0

The file has much smaller size than the file you send me, 163MB vs. 3.7GB :)

Notice that there are new subfields in the “branch” and “treedata” structure arrays, particularly “treedata” now contains a lot more information than previously in the form of distributions.

Attached you can find also the code to compute a lot of tree features for species and other possible classification purposes (this assumes the branch and treedata in the new format):

```
[FeatureValues,FeatureNames] = compute_features(QSMs);
```

Let me know if you have some problems with the codes, they may need some other functions from TreeQSM.

Cheers,
Pasi

On 8 Jun 2020, at 11.13, Kim Calders <Kim.Calders@UGent.be> wrote:

> Hi Pasi,
>
> I have selected one model for each tree now. Can you download this: https://filesender.belnet.be/?s=download&token=f62da441-7cf0-48ba-b314-274749b61a58
>
> Cheers - Kim
>
> > On 3 Jun 2020, at 08:31, Pasi Raumonen (TAU) <pasi.raumonen@tuni.fi> wrote:
> >
> > Hi Kim,
> >
> > Thanks for sharing the data. However, I was not able to download the file “qsm_opt.tar” because it is too big (> 36GB). I think this is the file that contains the QSMs that I want? I only need one QSM per tree and only the QSM output from TreeQSM. Can you help me with this? There is no hurry.
> >
> > Of course I will not share these with anybody else than my MSc student.
> >
> > Cheers,
> > Pasi
> >
> > > On 2 Jun 2020, at 16.19, Kim Calders <Kim.Calders@UGent.be> wrote:
> > >
> > > Hi Pasi,

The QSMs in Louise's paper are the same for the Nature CC paper (an update on that soon). I think I updated a few QSMs after Louise started using them.
You can find all of them, including the point clouds here: https://kimcalders.stackstorage.com/s/ugHkwRXnopEWkhG

Feel free to share this with your MSc student, but please don't distribute any further for now. I'll make all the data directly available with a data repo linked to the Nature CC paper.

Let me know if you have trouble downloading them. Ppl had some problems with *zip but, the *tar.gz files should work fine.

Cheers - Kim

> On 2 Jun 2020, at 15:09, Louise Terryn <Louise.Terryn@UGent.be> wrote:
>
> Zie email hieronder. Aangezien het jouw QSMs zijn…
>
> ---
>
> **From:** Pasi Raumonen (TAU) <pasi.raumonen@tuni.fi>
> **Sent:** 01 June 2020 10:24
> **To:** Louise Terryn <Louise.Terryn@UGent.be>
> **Subject:** Re: Update on paper "Tree Species Classification Using Structural Features Derived From Terrestrial Laser Scanning"
>
> Hi Louise,
>
> Here are my few comments on the responses to reviewers. I think we have good responses and there was not much criticism anyway. I think we are ready to resubmit.
>
> On the subject of species classification in general I have a suggestion, which I also mentioned briefly in my comments. I have a MSc student studying this problem and our approach is to first compute thousands of different structural features from the QSMs. I think we have now defined about 11000 features and we plan to add more. There are practically no limits how many features you could compute from QSMs. The problem then is how to select the useful features as most of the features are not useful or they correlate strongly with many other similar features and thus do not add useful information. I hope we can define and find features that would work better than the features you and Markku have been using, but we will find out that later. Anyway, do you want to collaborate with us in this study? We would find it very useful to have your QSMs from this paper for testing different features (and classifiers) and any ideas about possible feature definitions that you think might work. Also, do you know what are structural "botanic" features traditionally used to distinguish between different species?
>
> Cheers,
> Pasi
>
> > On 25 May 2020, at 19.25, Louise Terryn <Louise.Terryn@UGent.be> wrote:
> >
> > Hi everyone
> >
> > Last week I received news on the manuscript I submitted in February on Tree Species Classification Using Structural Features Derived From Terrestrial Laser Scanning:
> > "Reviewers have now commented on your paper and a Major Revision is recommended" (see partial email below)

>
> You can find the comments of the reviewers in the email below but everything they said is also in my "response to reviewers file" which you can find in the attachments together with the revised manuscript. Based on the comments this wasn't really a major revision though.
>
> The deadline for the submission of the revision is June 18th but I plan to submit it next week. Please send me an email before the 2nd of June if you have any suggestion or comments, I can always use some feedback! I hope to hear from you soon 😊.
>
> Kind regards
> Louise
>
>
> -----Original Message-----
> From: eesserver@eesmail.elsevier.com <eesserver@eesmail.elsevier.com>
> Sent: 19 May 2020 16:15
> To: Louise Terryn <Louise.Terryn@UGent.be>; terrynlouise@outlook.com
> Cc: sanna.kaasalainen@nls.fi
> Subject: Your Submission PHOTO-D-20-00135 to ISPRS Journal of Photogrammetry and Remote Sensing.
>
> Ms. Ref. No.: PHOTO-D-20-00135
> Title: Tree Species Classification Using Structural Features Derived From Terrestrial Laser Scanning ISPRS Journal of Photogrammetry and Remote Sensing
>
> Dear Miss Louise Terryn,
>
> Reviewers have now commented on your paper and a Major Revision is recommended. While the manuscript has a potential for publication in the ISPRS Journal, the final decision will depend on the quality of the revisions. If you are prepared to undertake the work required, I would be pleased to consider the revised paper for publication. (see below and on https://ees.elsevier.com/photo/).
>
> For your guidance, reviewers' comments are appended below.
>
> ###
>
> Yours sincerely,
>
> Derek Lichti
> Editor-in-Chief
> ISPRS Journal of Photogrammetry and Remote Sensing
>
> Reviewers' comments:
>
> Reviewer #2: Terrestrial laser scanning (TLS) is a revolutionary tool for forest inventory and forest ecology study. Although many metrics like DBH, stem density, LAI were estimated from TLS with promising accuracy, tree species classification using TLS were still a very challenging and less investigated task. The submitted manuscript aimed to explore automated tree species

classification for mixed species stands using only structural information derived from leaf-off TLS data. The topic is novel and appealing to readers in the ISPRS journal.
> Overall the experiment was well designed. I can see innovation in 2 aspects: 1) mixed-species forest plot were studied, where classification task was more difficult, with moderate classification accuracy achieved. 2) the study demonstrated that size-dependency increased intra-species variability while the convergence of structural traits and shade tolerance decreased inter-species variability. This provides valuable information for other researchers and users.
>
> However, the study is suggested to address the following issues before being considered as acceptable for publication. My main concerns are as follows:
> 1) The study provided no information to a key step, i.e. individual tree delineation for QSM generation.
> The QSM requires the point cloud of individual trees as input. In a mixed-species plot, how did the authors conduct segmentation to acquire individual tree point cloud? Was it done manually, semi-automatic or automatically? In the study, both understory and overstory trees were involved. A commonly used CHM based segmentation for ALS data did not seem to apply in this scenario. The researchers are suggested to present more details for this step.
>
> 2) What was the stem density for the plot of the study area?
> It is supposed that stem density plays great influence on the classification results. Especially when the plot was very dense, it would be more difficult to scan trees which are distant from the scanner. And neighboring trees perhaps have overlapped branches and unclear boundaries. In such case, the accuracy of derived structural features from QSM decreased. Was the plot homogeneous or heterogeneous in terms of tree density? As mentioned in the study, the plot was scanned in a 20*20 m grid pattern, would it be possible to present a tree distribution figure in that 1.4 hectare plot?
>
> 3) The results of this study raised concerns about practicability of TLS for forest tree species classification.
> Given the moderate classification accuracy (mean test accuracy 80%, producer accuracy 0-60%), the "structural trait only" classification strategy proved to be far from operational use, in my perspective. I had to question whether TLS fits for fast and automated collection of tree species info. The authors offered some advices including using mobile laser scanning (MLS) to speed up data collection, as well as data fusion with UAV LiDAR or hyperspectral data. This seems to be more applicable for urban forests, managed forests than primary and tropical forests. Perhaps the authors can add some discussion about this.
>
> Further detailed comments are listed below:
> Abstract:
> Line 34-35, "high classification performances have generally not been obtained", not very convincing due to lower classification accuracy of this study than (Lin 2016 & Akerblom 2017) Line 37, the use of "accurately" implies an accuracy evaluation of the 17 extracted structural features, which was not conducted.
> Page 6, Fig 1, do the authors have some digital aerial photos of the forest plot for better illustration?
> Page 10, Line 41, feature shedding ratio, "in the bottom third"?
> Page 13, Line 41, "The sensitivity is defined as the fraction of the smallest

group that is correctly identified", then how come the sensitivity was calculated for ACERPS, the largest group, in this study?
> Page 15, Table3, was Random Forest classifer used? No results were presented.
> Page 16 & 17, Fig 5, please add the name of each feature in the figure, instead of feature number, for better readability Page 24, Line 24, have the authors explored the structural straits of woody elements with the light condition? For instance with LAI in leaf-on conditions.
>
> https://ees.elsevier.com/photo/l.asp?i=279998&l=V6RVTQ33
>
> Please note that editors and/or reviewers have uploaded files related to this submission. To access these file(s) while you are not logged into the system, please click on the link below. (Note: this link will expire after 5 clicks or 30 days.) Alternatively, you may log in to the system and click the 'View Review Attachments' link in the Action column.
>
> <Response to reviewers 20200525.pdf><AFM_TSC_paper.pdf>

<Response to reviewers 20200526_HV_GN_PR.pdf>

convert_to_qsm_struct.m

branches2.m

tree_data2.m

compute_features.m