REFERENCE ALGORITHM IMPLEMENTATIONS IN OTB: TEXTBOOK CASES

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1. INTRODUCTION

How can an author give evidence of the performances of his published techniques? In most cases, papers come with a description of the technique featuring formulas, barely pseudo-code. Performances are evaluated on a limited data set chosen and commented by the author itself. Of course the reviewing process ensures the quality of the published materials but from the reader point of view, it is often hard to assess the performances of the described technique. And when it comes to comparing with other techniques, things are even worse. Initiatives like Openscience (`http://www.openscience.org`) or the Insight Journal (`http://www.insight-journal.org/`) bring a possible solution to this shortcoming: releasing an open source reference implementation along with the paper. The goal of the present paper is to emphasize the need for such reference implementations and to highlight the advantages of integrating them into a larger framework such as the ORFEO Toolbox. This document will be articulated on four experience feedback cases from ORFEO Toolbox developers, which can be considered as textbook cases of practices. Please note that papers and authors in the remainder of the document are only quoted for the need of the demonstration.

2. SIFT: KNOWN TO BE GOOD, HARD TO CODE

SIFT is a well known algorithm in those fields where you need robust and perturbation tolerant matching between images, such as robotics or image analysis. It is also used for panorama stitching in digital camera softwares like hugin (`http://hugin.sourceforge.net`). Its interest in the field of remote sensing seems obvious, and having it in the ORFEO Toolbox opens wide perspectives in object recognition and image registration chains. Looking at the publications like [1, 2], the overview of the algorithm mechanism is rather clear, but the implementation is touchy: there are numerous parameters to fine tune, as well as speed and performance optimizations. Moreover, for the sake of the readers comprehension, all these tuning and optimization tricks are not described in detail. Some initial or intermediate processing steps are also skipped from one paper to another, probably because the author was enhancing the algorithm while already publishing about it. As a result, we did succeed in developing an ORFEO Toolbox version of the SIFT algorithm, but the results are not comparable with those published by the author, and neither are the invariance and matching performances.

3. MEAN SHIFT: ONE STEP FORWARD

Mean shift is a non-parametric feature space analysis technique [3]. It locates stationary points of a density function given some discrete sampling of this function. In the image analysis field, the mean shift algorithm allows to perform clustering but also edge-preserving smoothing. In the latter case, the performances are at least similar to other well known techniques like anisotropic diffusion. Once again, the algorithm mechanisms are clear, but the implementation details are not described, especially for the clustering part. But one thing makes this case slightly different: the mean shift authors distribute Edison (`http://www.caip.rutgers.edu/riul/research/code/EDISON/`), a small library implementing the smoothing and clustering algorithm as described in the paper. We did wrap this library within an ORFEO Toolbox filter, and it is now available and can be interfaced seamlessly with any other part of the library, the icing on the cake being that we spotted and fixed some bugs. This highlights that everyone can benefit from reference implementations: not only other scientists, with available reproducible materials, but also the authors themselves, having their algorithm gracefully reviewed and sometimes corrected for free.

4. BAYESIAN FUSION: ALMOST HAPPY

Bayesian fusion [4] is a novel pan-sharpening technique contributed to the ORFEO Toolbox last year. Apart from the algorithm itself, the interesting point is that the author has sent detailed pseudo-code – in fact Matlab code – to the OTB development team, even before the paper was published. By the time the paper was made available, the algorithm was shipped with the latest OTB release, and the author did advertise for it in the paper itself. Everyone can experiment with the algorithm and compare it with other pan-sharpening techniques available in the library. Of course, it would have been even better if the author had sent C++ code, but provided that there where people having time to translate, once again, everyone benefitted from this deal.

5. ROAD EXTRACTION: REPRODUCIBLE EXTRACTION

Finally, there is the case of the road extraction algorithm [5]. This technique allows fast extraction of the road network in high resolution images in an almost unsupervised way. The only required input is the value of a pixel belonging to the road. For this publication, the authors did their experiments using OTB. Therefore, when the algorithm was ready for publishing, the full code was already available and ready to be integrated into the library. Of course, the authors did advertise on this point. Since they made this road extraction chain highly modulable, it is now being used for the purpose of other network extraction by only changing a few modules.

6. CONCLUSION

As a conclusion, through these cases, we demonstrated the fact that providing a reference implementation along with a publication is an important point in sharing knowledge and reproducible science with other scientists. We have shown that both the authors and other scientists can benefit from this practise. There are many ways to distribute this reference implementations, and the ORFEO Toolbox provides an interesting framework to do so. Among its numerous advantages, we can note easy interfacing and competition with other algorithms, standard interfaces, code review and correction as well as increased visibility from the community. The best way to convince people of the quality of your algorithm is to allow them to experiment with it.

7. REFERENCES

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