CROWD-SOURCING SATELLITE IMAGE ANALYSIS

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1. INTRODUCTION

Satellite image analysis is a time consuming task whose outputs may be requested in very short time frames, as for instance in rapid mapping for disaster management. Unfortunately, automatic algorithms do not reach the quality of results of human operators. Recently, with the new communication tools available, the wisdom of crowds [1] has encountered a great success. In the domain of geographic information, Open Street Maps (`http://www.openstreetmaps.org`) is widely known and is getting increasingly popular. Private companies like Google and Microsoft have launched their own version of community-based geographic information gathering. However, since the satellite imagery is not easily available for analysis, there is some room for progress in this domain. In the case of Google Maps, for instance, the user is not allowed to download and process the satellite images, and therefore, she can not make available the results of automatic information extraction techniques.

2. COMMUNITY DATA TO HELP SATELLITE ANALYSIS

The first possibility to overcome these difficulties is to use the data produced by the community as a way to improve the quality of the analysis (see [2] for an example of techniques allowing to improve available geographical data bases by fusion of satellite imagery). The amount of freely available information is already important and the progress is exponential.

First, the data available can be used to increase the geometrical accuracy of the data itself. Of course, the accuracy of the community data is not perfect, but it has been found to be of very good quality compared with the traditional dataset available [3]. Using a registration of image to a vector database (see Fig. 1), the geometric accuracy of the available imagery may be improved.

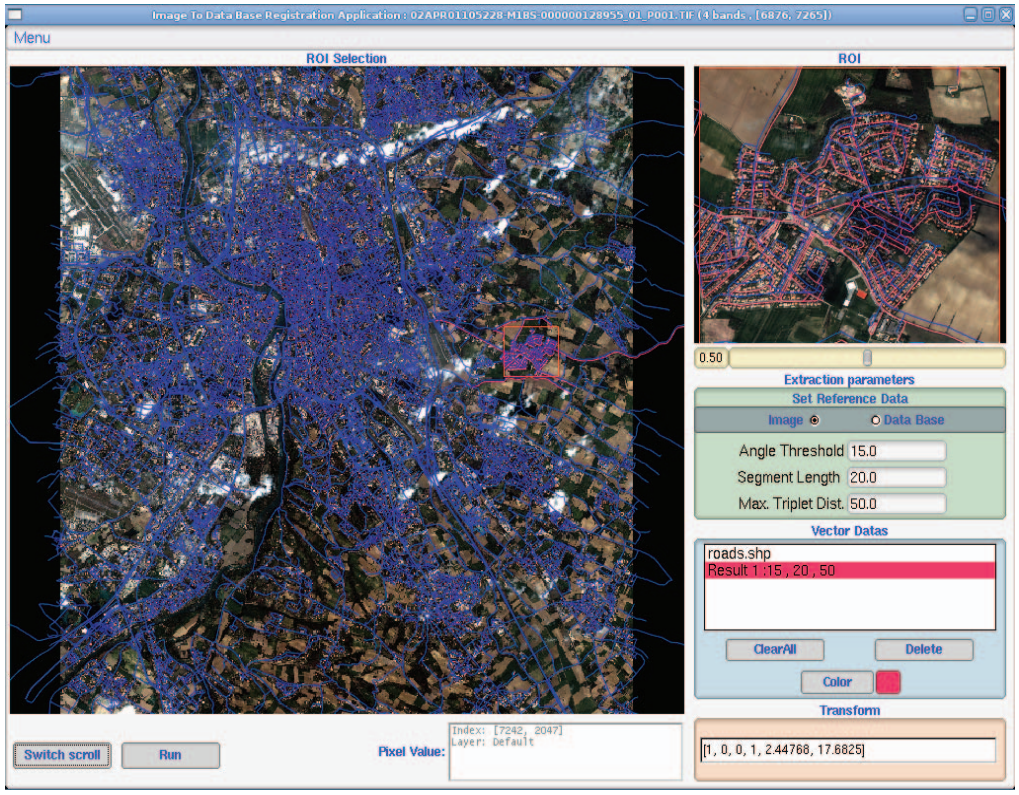
3. USE SATELLITE DATA TO IMPROVE THE COMMUNITY INFORMATION

Satellite data provides a unique representation of the Earth in terms of accuracy, completeness and coverage. Once the analysis and information extraction is performed from the satellite image (using automatic means for example), the information will not be expected to be perfect: in terms of location (some accuracy errors we mentioned earlier), in term of semantics (it can be difficult to identify objects from above) and in terms of temporal variation (something that was here when the satellite saw it, may change later on).

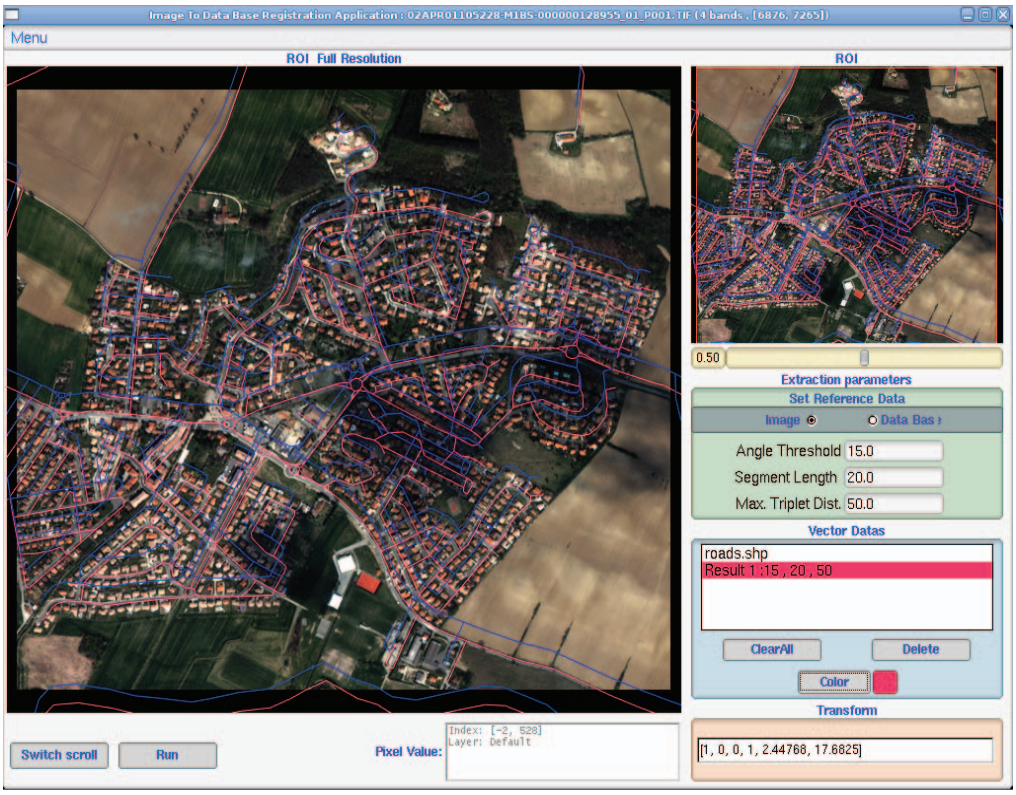
By providing this information back to the community, one can expect that these discrepancies will be corrected and that the overall quality of the data will improve.

For this approach to work, efficient tools for image analysis (see for example Fig.2) are of course needed, but, added to the algorithmics, the capability to access the data available on-line is extremely important. That is, processing chains should be able to process locally stored data or data available on the net (Open Street Maps, Google Maps – when allowed by the owners–, etc.) seamlessly.

Our teams work on the development of such tools and also on making the widely and freely available. For instance, our open source remote sensing image analysis software, the Orfeo Toolbox (`http://www.orfeo-toolbox.org`) is able to access the Open Street Map API, and therefore, it allows the user to see this huge amount of geographical information as if it was locally available (Fig.3).



(a)



(b)

Fig. 1. Improvement of the sensor localization by database matching (a) processing of a complete Quickbird scene and (b) zoom

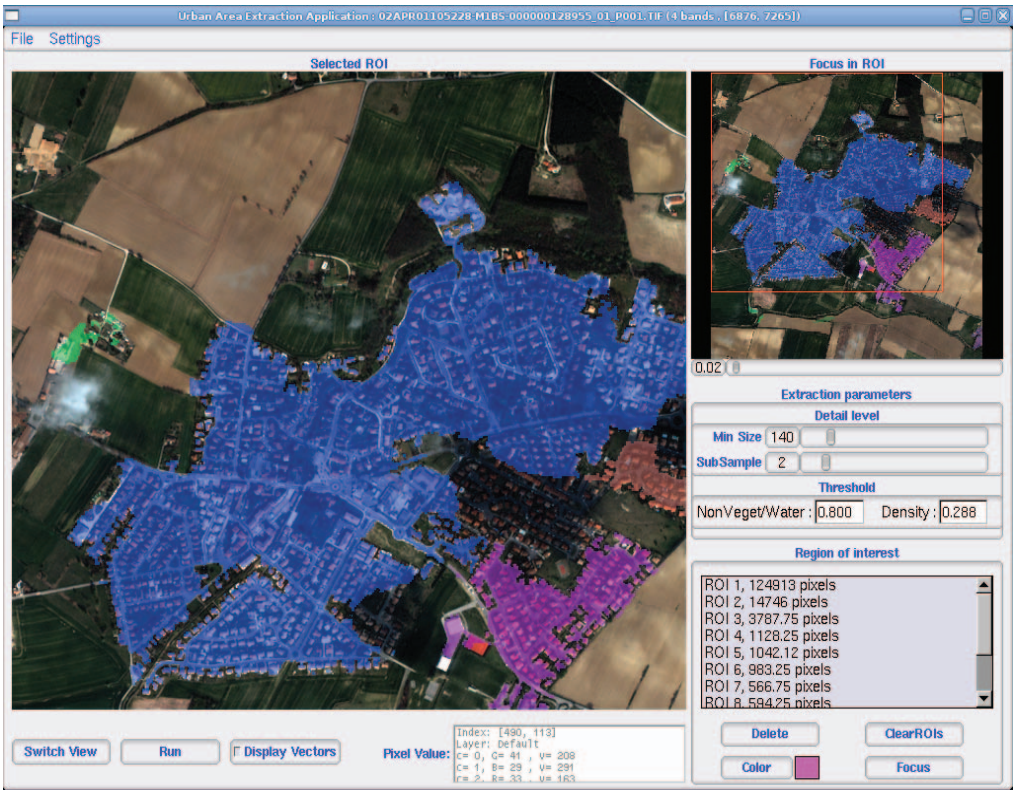


Fig. 2. Automatic urban area extraction using texture features

Fig. 3. Combining open street map data with high resolution satellite image

4. USING THE COMMUNITY TO ANALYZE SATELLITE DATA

The third development axis relies on using the community to directly analyze the satellite images. Everyday, terabytes of information are produced worldwide by satellites. Most of the images end-up in storage and will never be analyzed. In this context, it is particularly tempting to try to harvest some of the 9 billion hours per year mankind spends playing solitaire for a more useful purpose. Earlier tentatives in the field of pattern recognition have proven to be very successful, especially when the task is presented as a game to the user [4].

In the context of humanitarian crisis, it is relatively easy to get the public attention and to engage the community. In the aftermath of the hurricane Katrina in 2005, a significant portion of the information was gathered by volunteers using the Google Earth interface.

The idea here is to provide a free and easy access to recent images, particularly in the context of crisis and use the information gathered by thousands of volunteers to get a better picture of the event. Of course, the quality of the information extracted by each volunteer will be no match compared with the information a professional and trained expert can retrieve. But by combining the different results obtained by each volunteer the final quality will improve. Even better, the points of disagreement between participants can be used to focus the expert.

5. AVAILABILITY

Of course, crowd sourcing cannot work without the wide availability of the tools. The applications illustrated here will be available in the Orfeo Toolbox, an open-source software [5] so that users can participate and also increase the range of available applications. The applications presented on Fig. 1, 2 and 3 are already available for download.

6. CONCLUSION

A realization combining Open Street Map data with satellite image analysis will be presented, showing how community human processing can increase the knowledge extracted from satellite images.

7. REFERENCES

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[4] Luis von Ahn, "Games with a purpose," *Computer*, 2006.

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