# Segmentation methods based on spatial characteristics of multispectral images

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The importance of remotely sensed images increases parallel to the technology development. The quality of digital images is improving while their unit cost decreases. Accordingly, processing and information extraction methods must also evolve. It is clear that the vast data set of images can also generate a lot of practical problems. These are the unacceptable processing time, and those areas where human interaction can't be eliminated. This decreases efficiency and may cause some unpredictable error.

Our paper concentrates on agricultural applications of remotely sensed images. These include area estimation and early yield forecast. Remotely sensed images convey information about a certain area of the Earth's surface. The image data can be considered as a matrix, in which each element (pixel) consists of a so-called radiation intensity vector. This is quantitative data from an elementary unit of the surface. The radiation is measured by the sensors on board of the satellites.

As a starting procedure we can process pixels individually, ignoring their spatial properties and relationships. However, the adjacent matrix elements belong to adjacent spots, therefore these pixels are similar. Consequently, it's often useful to treat neighbouring similar pixels as a unit, called segment. A possible and sometimes better approach is to start to find segments, the homogeneous, spatially contiguous set of pixels. The segments are used as the basic elements in the course of further processing.

The advantage of the segmentation is particularly obvious if we consider the next processing phase, the clusterizing. Its purpose is to divide the similar pixels into a given (or restricted) number of data vector classes. In the straightforward (per pixel) approach clusterization doesn't utilize spatial relationship between pixels, it treats and evaluates the single intensity vectors in an isolated way. Therefore this approach sometimes does not recognize relations that are obvious to the human interpreter. The segmentation makes the classification easier, helps visual interpretation, and—as the number of segments is much less than that of pixels—decreases processing time.

Added auxiliary knowledge of some administrative boundary information may also highly improve the classification accuracy. The first, most common step in this way is to use the parcel boundaries database. Obviously, in the majority of cases the pixels' spatial structure is strongly correlated to this administrative subdivision. Therefore it seems appropriate to classify the pixel sets determined by parcels. This provides a good basis for the classification. In the process of segment delineation we can restrict the procedure within the current land parcel. This not only helps in adequate ground segments, but also enormously increases speed, as we have to test much less cases. In part of the cases administrative subdivision provides more usable information to the classification than segmentation does.

A sound theoretical background and the segmentation algorithm is based on a former technical report and article. The algorithm can be divided into two levels, both based on statistical hypothesis tests. At the first level the image is partitioned into small rectangular areas, called cells. At the second level the algorithm merges similar cells into segments. Its results are improved and adapted to the present application and conditions. The current processing technology allows us to study a much wider range of parametrization and to run the algorithm on larger data sets.

Our paper focuses on this segmentation process, presenting a considerably fast algorithm with some flexibility in parametrization. We also aim to evaluate the advantages and possibilities provided by these methods. The further goal is to develop a complete classification system that processes segmented images. This would yield a substantial improvement of the presently used methods. Towards this goal, a representative artificial data set will be used to validate the efficiency of the "per-field" approach. Our expectation seems to be realistic, because the intended method incorporates spatial information into the classification.

The importance of the utilization of advanced, proper and adequate methods in the applications of satellite images is particularly high in operational programs. Based on a vast 300 man/year R+D investment by FÖMI Remote Sensing Centre in Hungary, a national Crop Monitoring and Production Forecast System has been operational for four years now. Improvement in adequacy, speed and reliability is a continuous requirement to the program. A special problem, a possible direction of development is addressed by this study.

## References


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