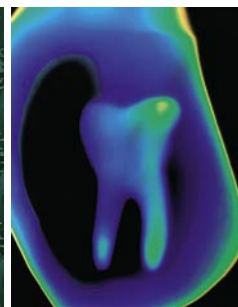
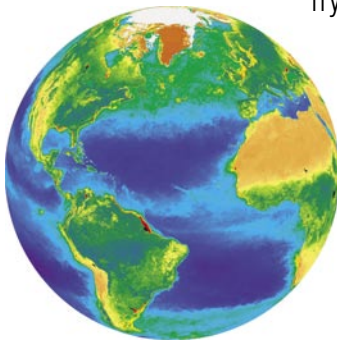




software technology

# Recursive Hierarchical Segmentation (RHSEG) Pre-processing Software

...for faster, highly accurate analysis of single band, multispectral, or hyperspectral imagery data at resolution up to 8000x8000 pixels



NASA Goddard Space Flight Center invites companies to license this image segmentation software for use in commercial applications. Optimized for speed and accuracy, RHSEG significantly improves the extraction of patterns from image and nonimage data sets, while providing the user with precise control. Originally designed for remote sensing, the RHSEG Pre-processing Software can improve pattern recognition and extraction in a broad range of applications from medical imaging to data mining.

## Benefits

- Improved analytical capabilities:** Optional weighted spectral clustering allows the grouping of similar but non-spatially adjacent regions, providing a more robust object representation.
- Increased speed:** The software's divide-and-conquer approach and parallel implementation increase the speed of computation, making it practical for extremely large data sets.
- Refined results:** RHSEG presents results in a hierarchical set of image segmentations, enabling selection of results for additional analyses.
- Flexibility and control:** RHSEG provides the user with the flexibility and control to tailor the regions of interest based on the purpose of the analysis.
- Accuracy:** Because the software maintains full spatial resolution at all region boundaries, it provides finer resolution of overall detail and a more accurate portrayal of boundaries.
- Ease of use:** The HSEGVier provides an easy-to-use way to view, analyze, and understand the output of the RHSEG Pre-processing Software. It also allows users to identify and label specific features of an image.

## Applications

RHSEG is useful for preprocessing both image and nonimage data for further intelligent analysis. Possible applications include but are not limited to:

- Aircraft or satellite remote sensing
- Medical imaging
- Drug development
- X-ray imaging
- Data mining
- Facial recognition
- Thermal imaging

## The Technology

The RHSEG approach involves partitioning two-dimensional imagery data into regions at various levels of detail. Using this approach, regions of data at coarser levels of detail are hierarchically related to regions of data at finer levels of detail. Following processing by the software, data are grouped and can be analyzed in terms of hierarchically related regions, rather than as individual data points, enabling a more consistent and accurate analysis.

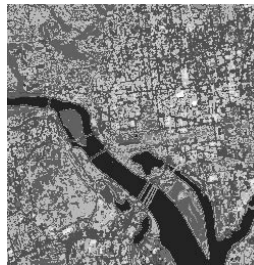
The software begins with an initial partitioning of the image data and then compares each region with spatially adjacent regions. The most similar pairs of spatially adjacent regions are then combined to form larger regions. At the user's option, pairs of non-spatially adjacent regions are then compared and those regions that are at least as similar as the previously compared spatially adjacent regions are combined. This process continues until a prespecified minimum number of regions is reached (depending on the detail desired). At this point, the segmentation results are monitored for significant changes between each iteration. This comparison process continues until a two-region segmentation is reached. The hierarchical nature of the segmentation results allows the user to choose which level of segmentation best accommodates the purpose of the data analysis or to combine levels to arrive at a hybrid of segmentations that makes the image objects of interest clearly visible.

### Available versions

The RHSEG software is available in three versions. One version (Core RHSEG Software) is available for use under general public software release. The other two versions (Artifact Elimination Version and Enhanced Performance Version) are patent pending and are available for licensing. An additional program, HSEGViewer, which helps the user view and interact with the output from RHSEG, is also available for use under general public software release.



(a) 7-region level from segmentation hierarchy



(b) 50-region level from segmentation hierarchy



(c) 11 regions selected from the 7-region, 25-region, and 50-region levels of the segmentation hierarchy

## Partnering Opportunities

This technology is part of NASA's Technology Transfer Program, the goal of which is to transfer technologies into and out of NASA to benefit both NASA space missions and the American public. NASA invites companies to consider licensing the RHSEG Pre-processing Software technology for use in commercial applications.

## For More Information

If you are interested in more information about RHSEG (GSC-14305/14681), please contact:

**Office of Technology Transfer**  
**rhseg@gsfc.nasa.gov**

More information about working with NASA Goddard's Office of Technology Transfer is available online:  
**<http://techtransfer.gsfc.nasa.gov>**

**Explore. Discover. Understand.**

**W W W . n a s a . g o v**