

## Image Segmentation and Analysis Method for 3- or Higher-dimensional Images

*This system and method identifies optimal surface and boundary regions in 3- or higher-dimensional images containing multiple intersecting objects.*

### Technology Primer:

Image segmentation techniques are widely used in various settings ranging from simple graphical image processing to complex medical image analyses. The advanced imaging technologies have enabled visualization of many objects that are far beyond the capability of human eyes. However, accurate and detailed analysis of captured images for specific features would require equally advanced image analysis tools. For instance, analysis of a volumetric or a three-dimensional medical image containing multiple intersecting boundaries and surfaces can be a daunting task without the help of a computerized image analysis tool capable of accurately identifying the diseased areas. Despite numerous computing techniques that have been developed in this regard, performing the segmentation directly on a three or higher dimensional image is limited by many challenges to be overcome.

### Technology Benefit:

**N-DIMENSIONAL DATA ANALYSIS SOFTWARE.** This computational analysis tool used directly on 3- or higher dimensional image can produce more consistent results yielding more accurate representation of object surface instead of sets of individual contours from stacking multiple 2-D image slices. The same method can be used for any scalar or vector function in n-dimensional space.

**MULTIPLE OPTIMAL SURFACE DETECTION.** The layered net surface model and minimization of total cost-function allows simultaneous detection of intersecting boundaries and surfaces contained in volumetric images. Object surfaces also can be cylindrical or spherical.

**TOPOLOGICAL ADAPTABILITY.** Net surface model and optimal surface detection enable highly faithful segmentation result from 3-D/4-D images of objects like the human airway tree whose topologies may change flexibly.

### Technology Description:

Researchers at University of Iowa have developed a graph-based n-dimensional image segmentation method that can be used directly on three or higher dimensional images. The same principle can be applied to any n-dimensional data sets containing non-image information. An image as well as any scalar or vector function in n-dimensional space can be represented by series of individual coordinates having measurable properties that can be analyzed by the series of computational algorithms to determine whether a set of coordinates are on a continuous line and/or surface. The method validation has been completed by using volumetric medical images from CT, MR, and ultrasound, and the results demonstrated accurate and simultaneous detection of multiple intersecting edges and surfaces. This method also provides significant improvements to the previous attempts on expanding the graph-searching segmentation techniques to analysis of data sets with higher dimensions.

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### Complementary Technologies:

**Category:** Information Technology

**Primary Sub-Category:** Software Design & Methods

**Secondary Sub-Categories:**

Signal Processing & Imaging  
Medical Imaging (CT/PET/MRI/Ultrasound)