

The Contour Spectrum



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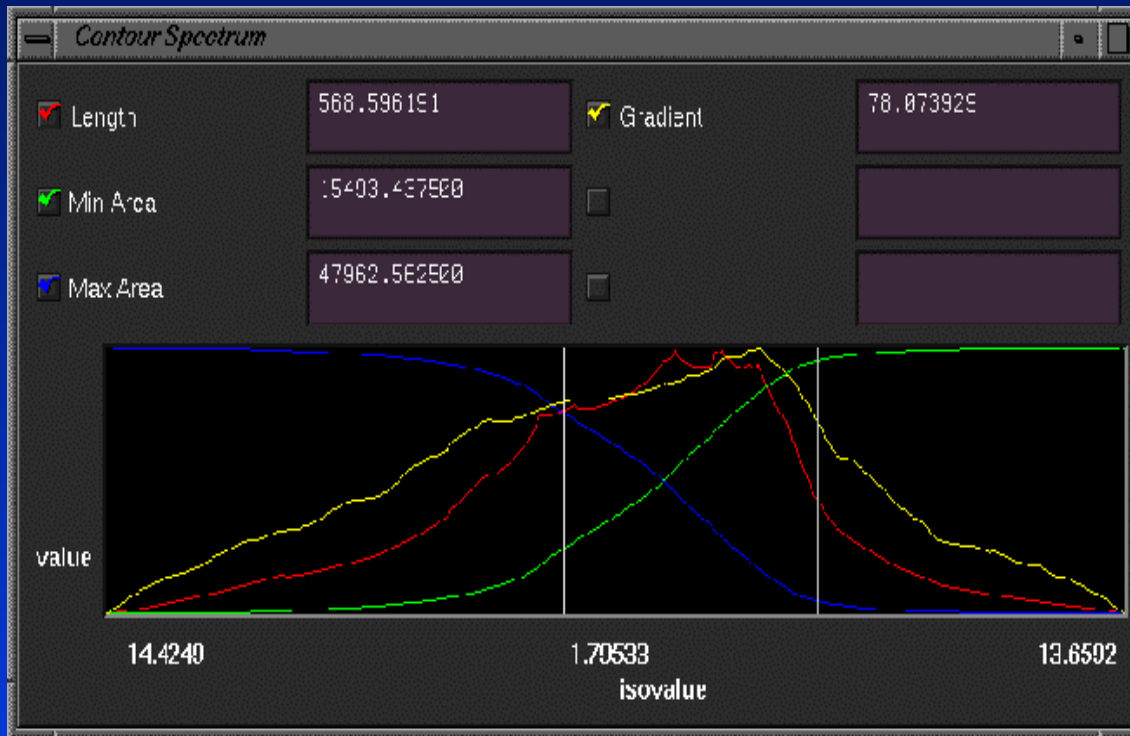
<http://www.cs.purdue.edu/research/shastra>

Outline



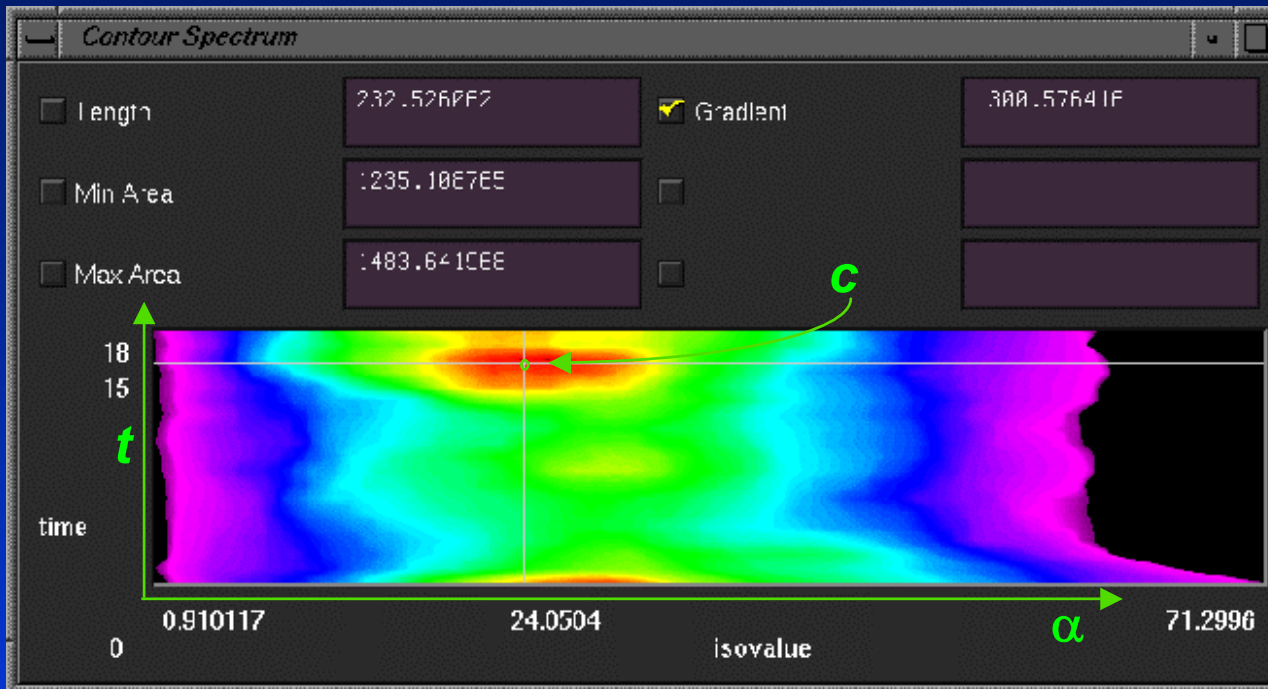
- ***User Interface***
- ***Signature Computation***
- ***Real Time Quantitative Queries***
- ***Rule-based Contouring***
- ***Topological Information***
- ***Future Directions***

Graphical User Interface for Static Data



- The horizontal axis spans the scalar values α .
- Plot of a set of **signatures** (length, area, gradient ...) as functions of the scalar value α .
- Vertical axis spans normalized ranges of each **signature**.
- White vertical bars mark current selected isovalues.

Graphical User Interface for time varying data



high

$(\alpha, t) \rightarrow c$

The color c is mapped to the magnitude of a signature function of time t and isovalue α .

magnitude

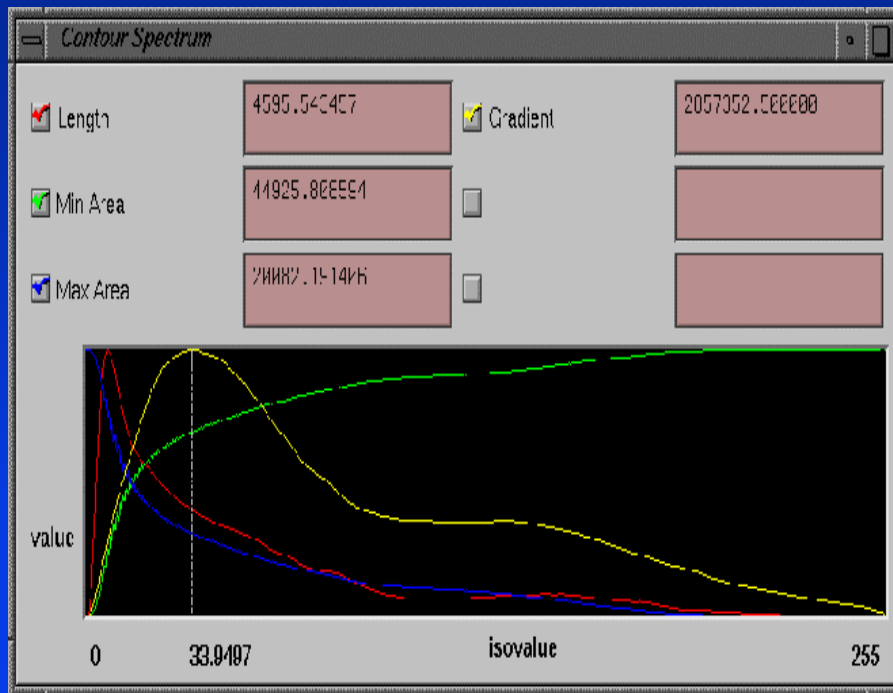
low

- The horizontal axis spans the scalar value dimension α .
- The vertical axis spans the time dimension t .



User Interface - MRI of a human torso -

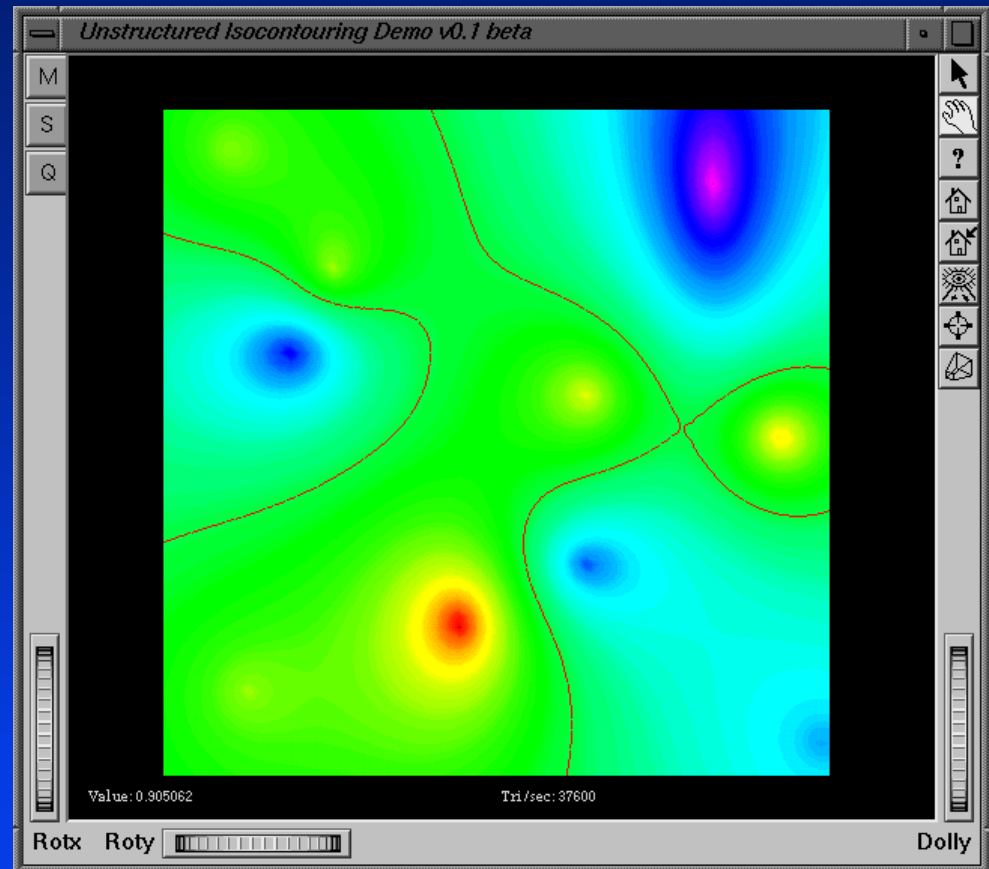
- The isocontour that bounds the region of *interest* is obtained by selecting the maximum of the gradient signature.
- In real time the exact value of each signature is displayed.



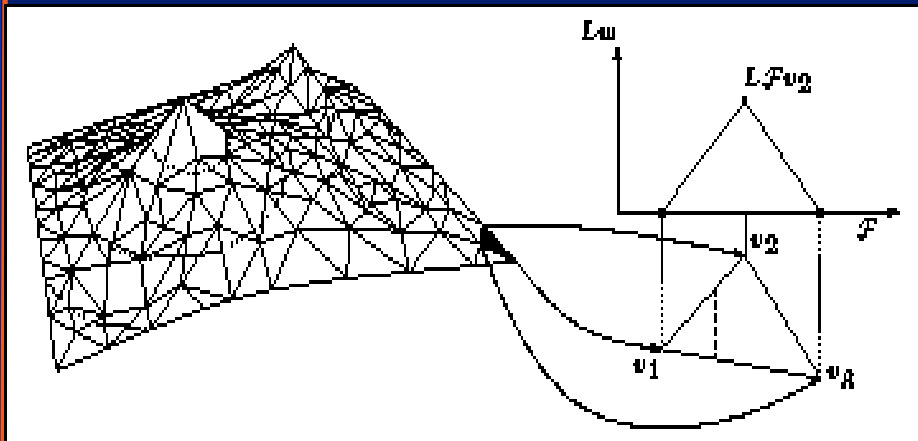
Signature Computation



Consider a terrain of which you want to compute the length of each isocontour and the area contained inside each isocontour.

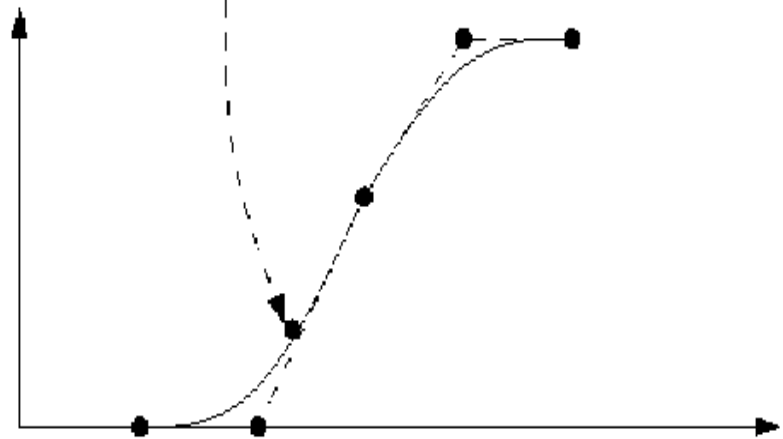
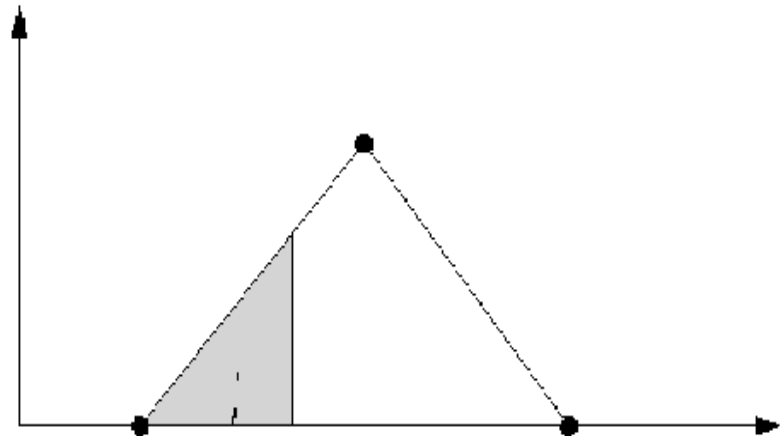


Signature Computation



- The length of each contour is a C^0 spline function.

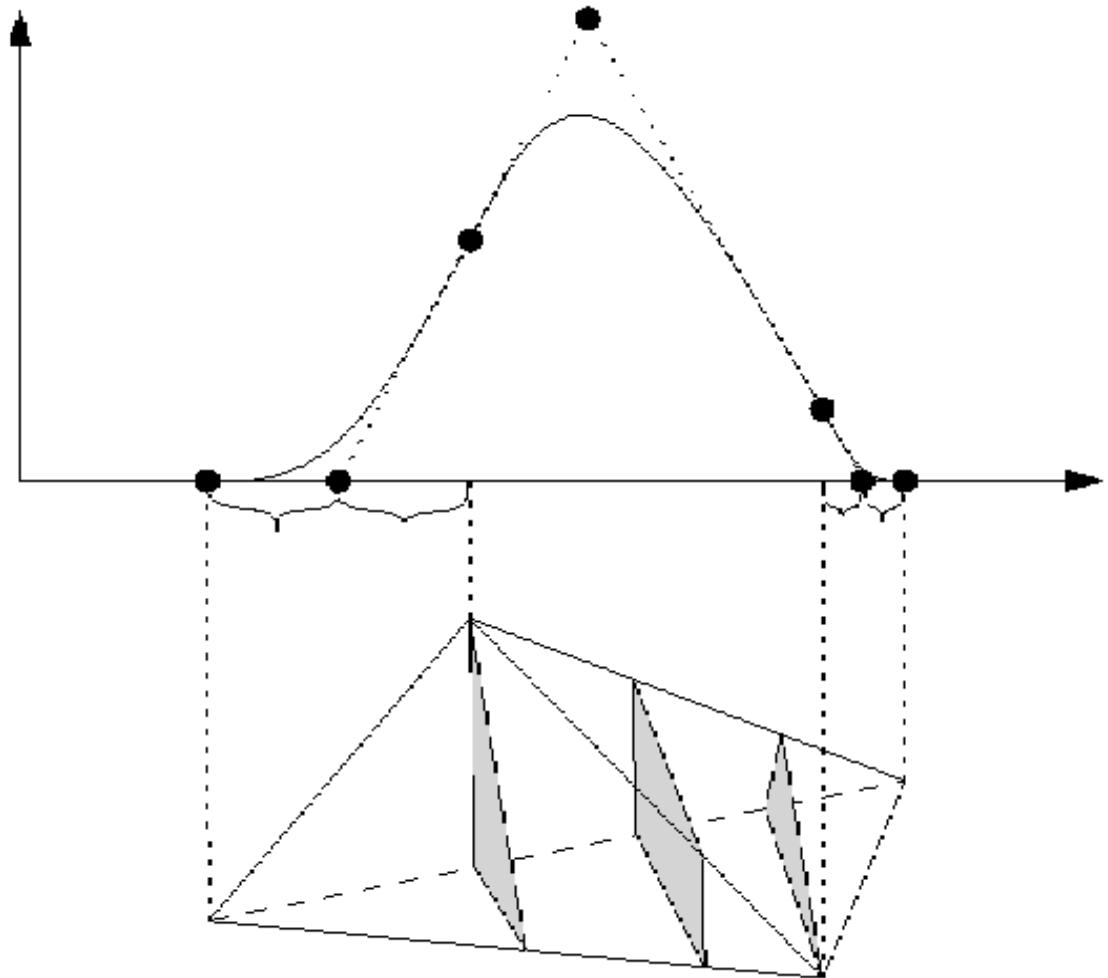
- The area inside/outside each isocontour is a C^1 spline function.



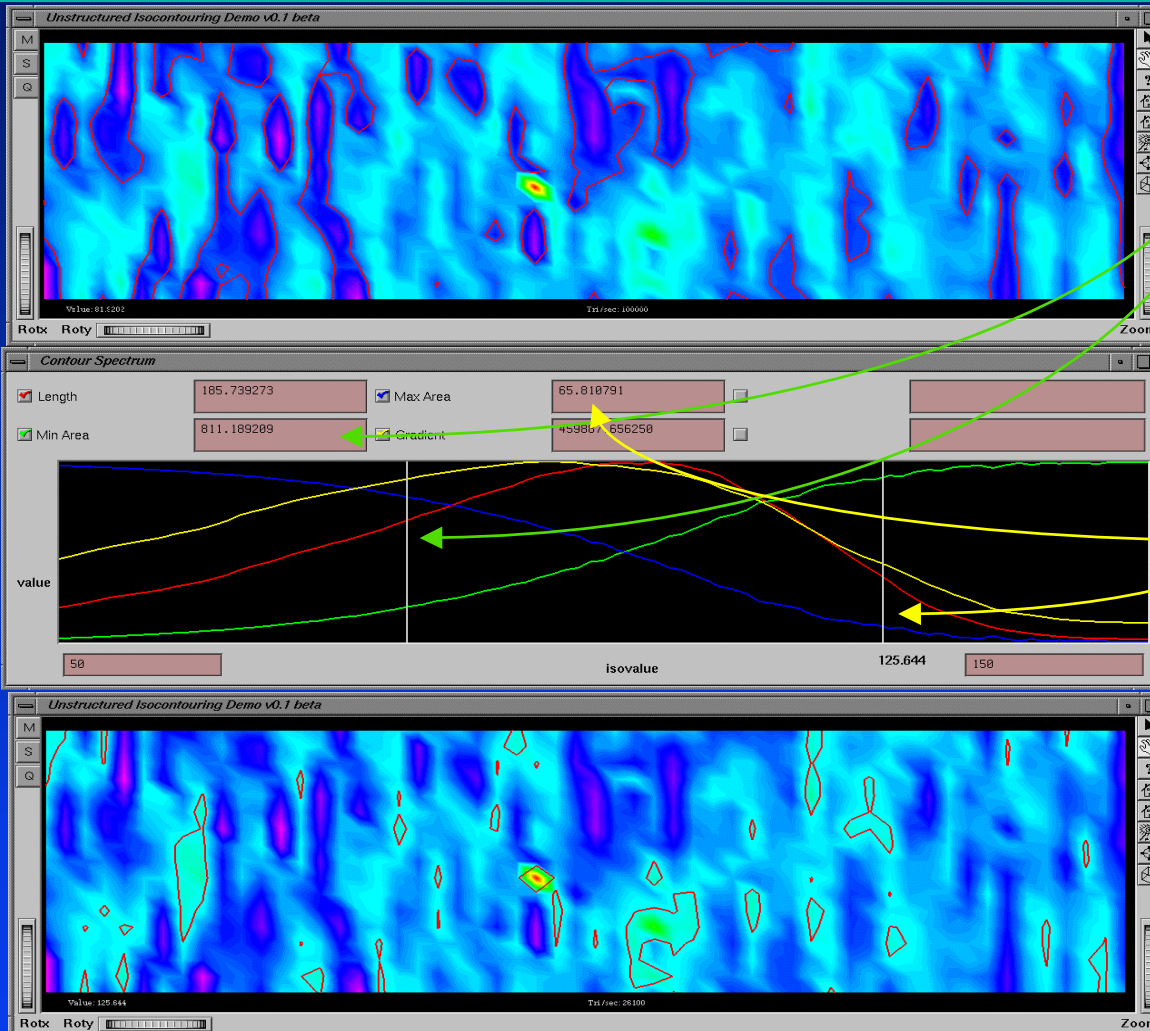


Signature Computation

- In general the size of each isocontour of a scalar field of dimension d is a spline function of $d-2$ continuity.
- The size of the region inside/outside is given by a spline function of $d-1$ continuity



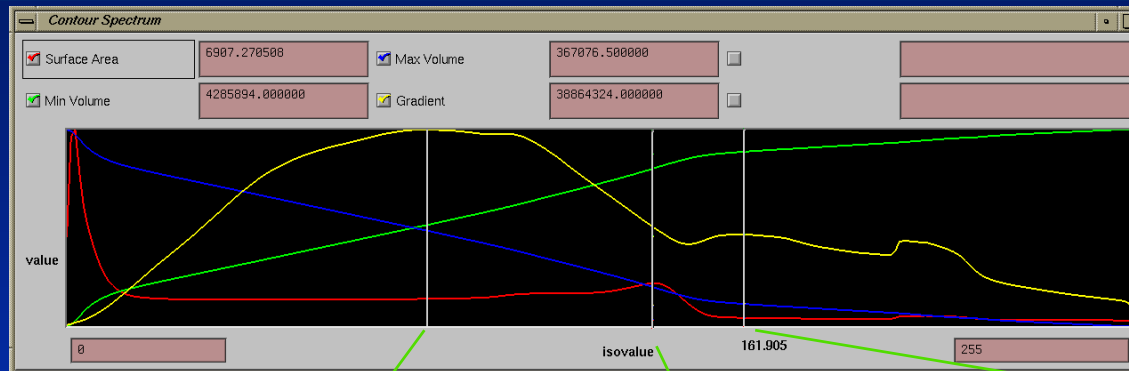
Real Time Quantitative Queries (agricultural yield data)



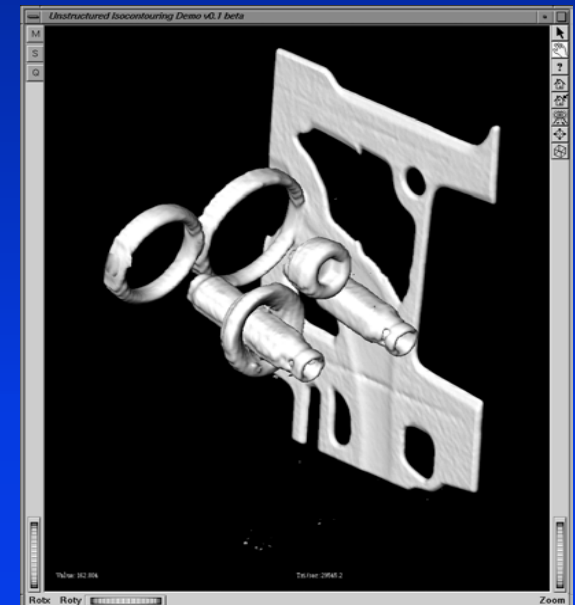
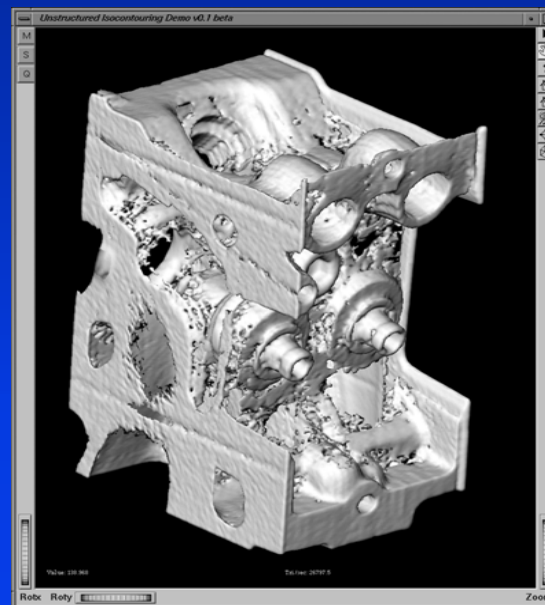
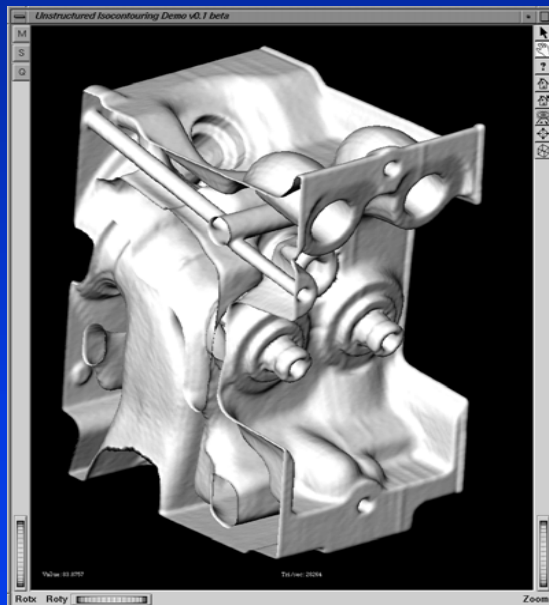
size and
position of the
region with
unsatisfactory
production

size and
position of the
region where
wrong data
acquisition
occurred

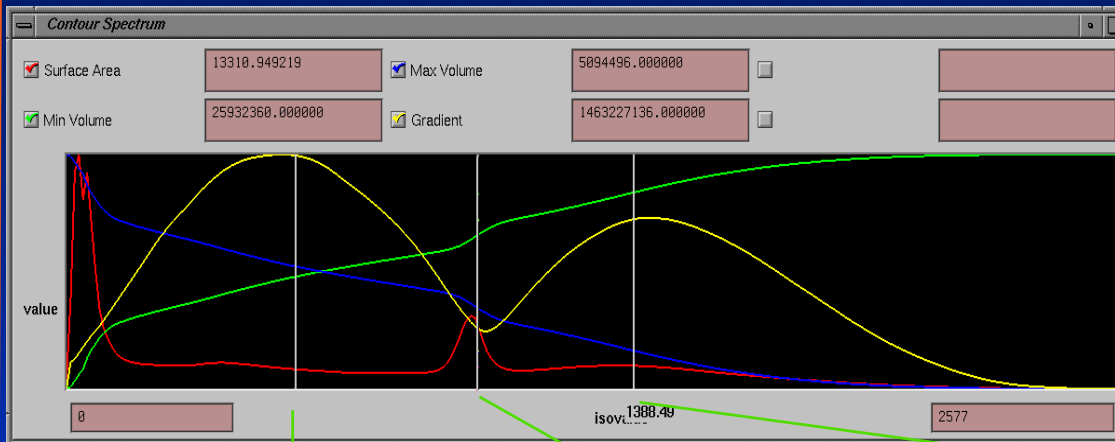
Rule-based Contouring (CT scan of an engine)



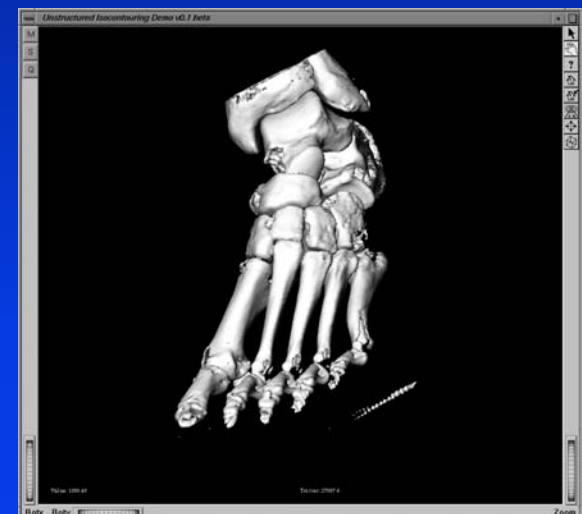
The contour spectrum allows the development of an adaptive ability to separate *interesting* isovalue from the others.



Rule-based Contouring (foot of the Visible Human)



The contour spectrum allows the development of an adaptive ability to separate *interesting* isovalues from the others.

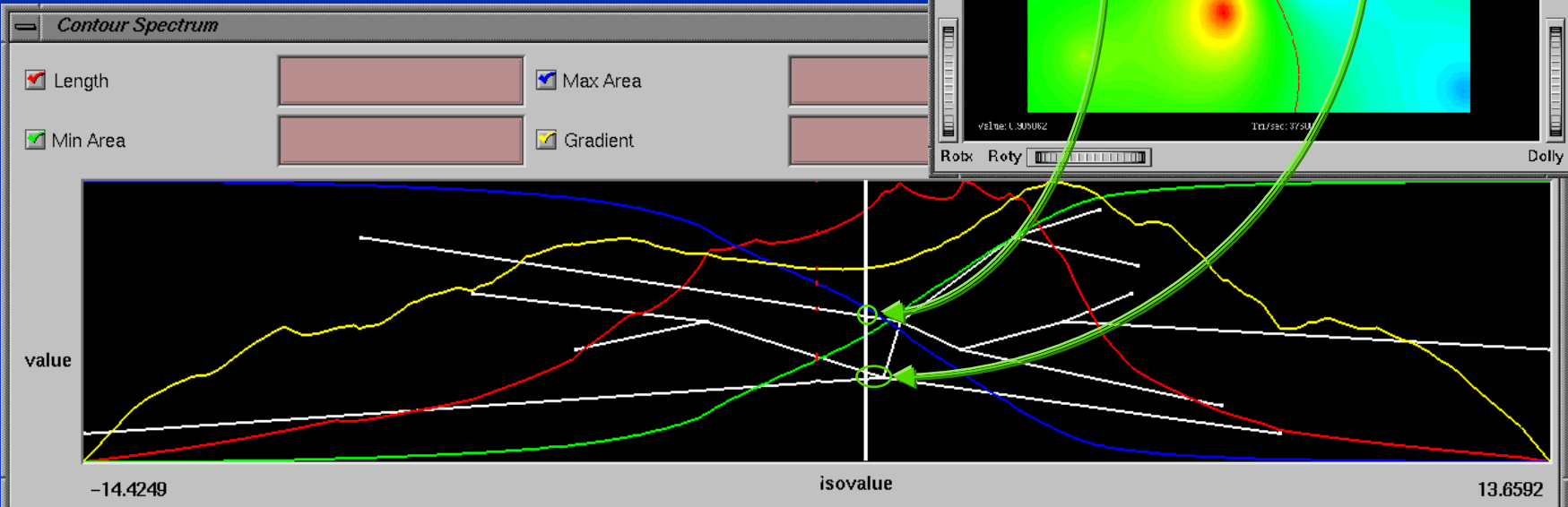
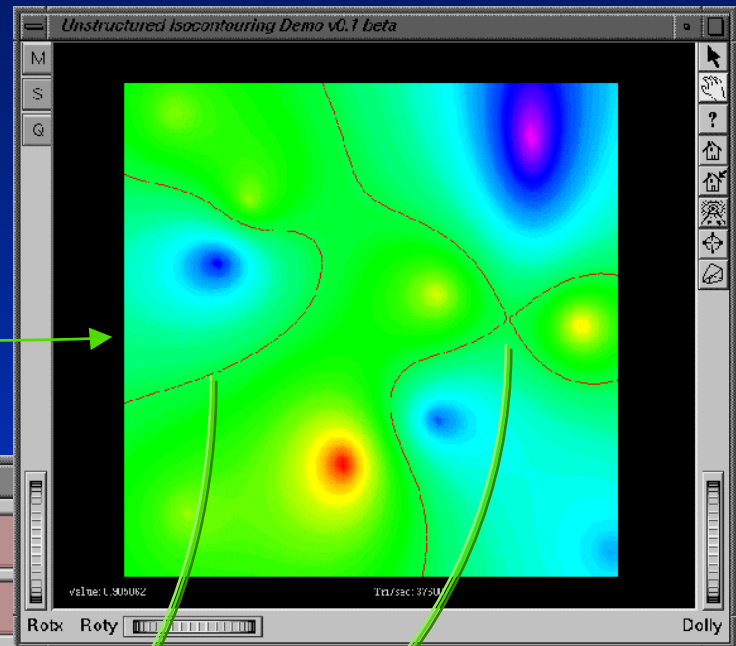


Topological information.



- number of components per isocontour
- which isocontours merge together or split while modifying the isovalue.

an isocontour with three connected components two of which are about to merge



Future Directions



- **exact computation for higher order interpolation and different type of meshes.**
- **experiment with other signature functions both for general purpose interface and for specific field of application.**
- **develop signature for vector field data.**
- **develop vector field signature and interface for both scalar and vector field datasets.**