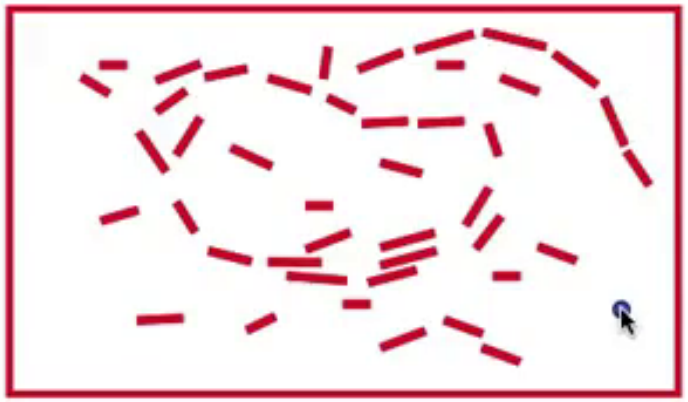
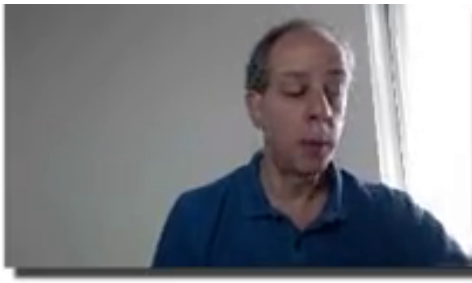
Edge Detection

- Edge Detection:
  - The process of labeling the locations in the image where the gray level' s "rate of change" is high.
    - OUTPUT: "edgels" locations, direction, strength



- Edge Integration:
  - The process of combining "local" and perhaps sparse and non-contiguous "edgel"-data into meaningful, long edge curves (or closed contours) for segmentation
    - OUTPUT: edges/curves consistent with the local data

Edge Detection



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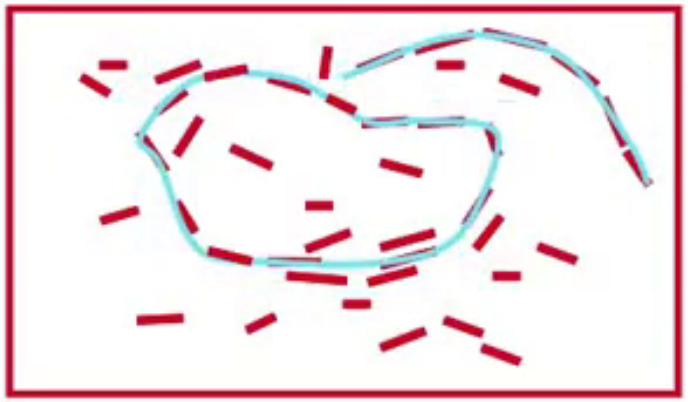

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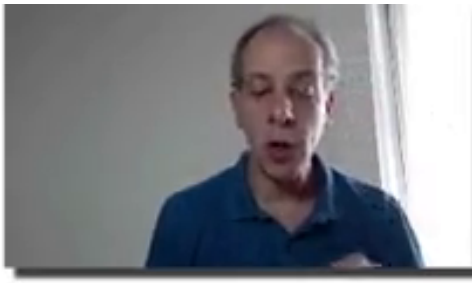
Active Contours



Image

Edge Indicator Function

$$g(x,y) = \frac{1}{1+|\nabla(G_\sigma * I)|^2}$$

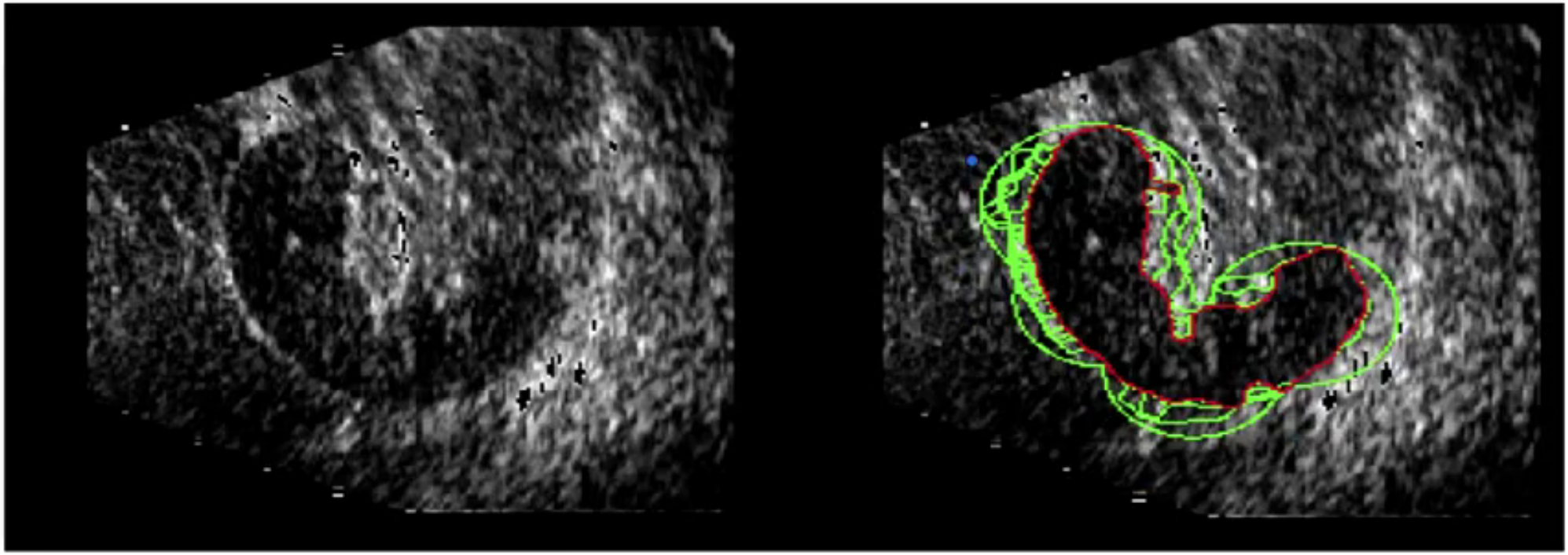
"nice" curves that optimize a functional of g( ), i.e.

$$\int_{curve} g(\,)ds$$

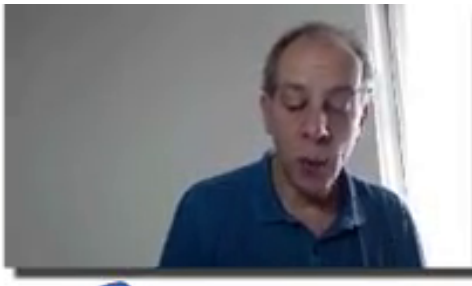
nice: "regularized", smooth, fit some prior information

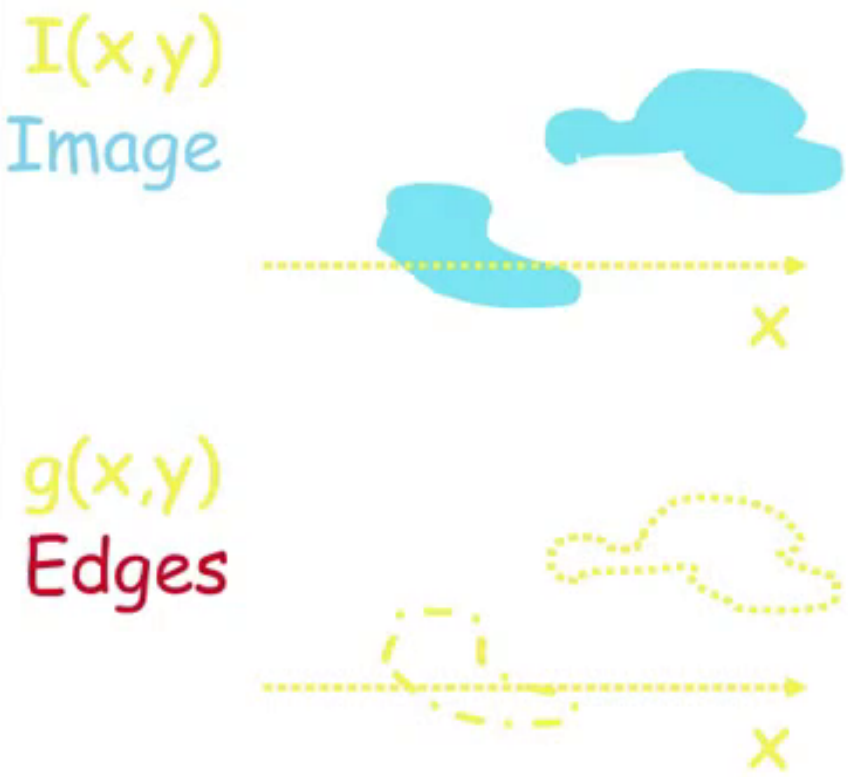
Edge Curves

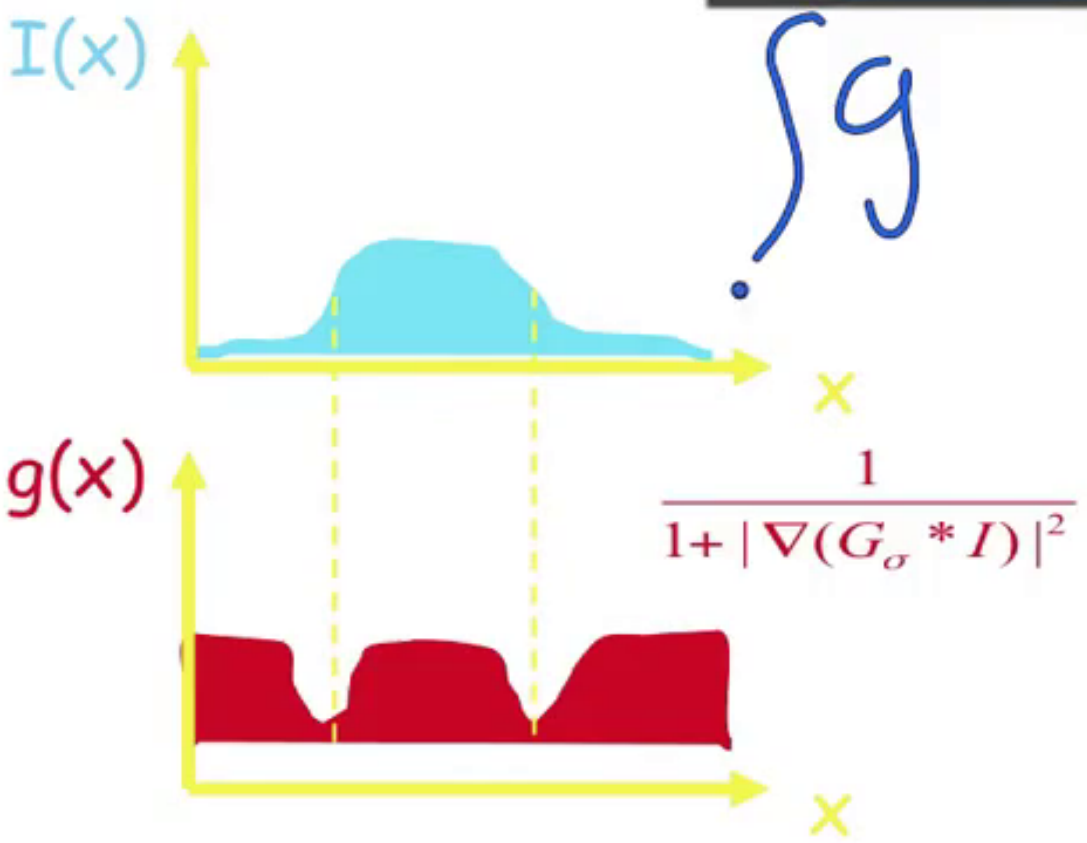
Segmentation



Potential Functions





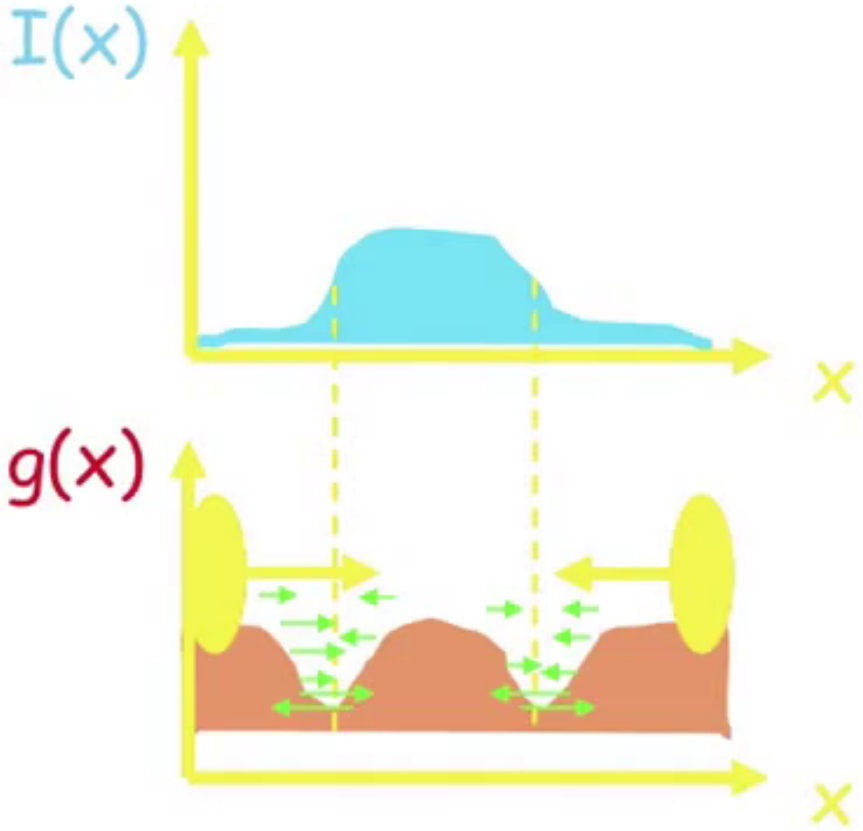


Geodesic Active Contours in 1D

Geodesic active contours are reparameterization invariant

$$\frac{dC}{dt} = \left(g(C)\kappa - \left\langle \nabla g(C), \vec{N} \right\rangle\right)\vec{N}$$

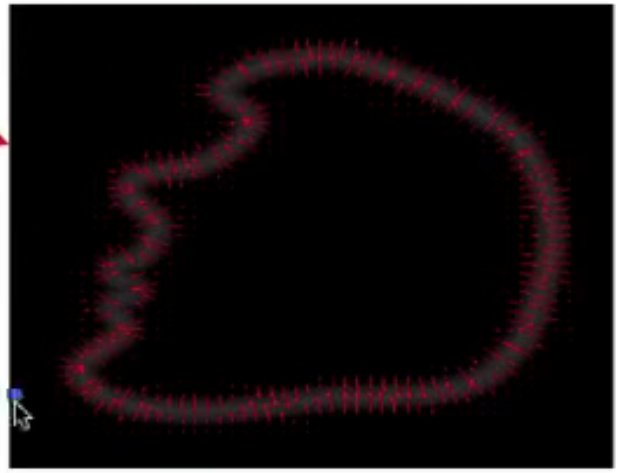
$\int g$



Geodesic Active Contours in 2D

$G_s * I$

$$g(x) = \frac{1}{1 + |\nabla(G_\sigma * I)|^2}$$



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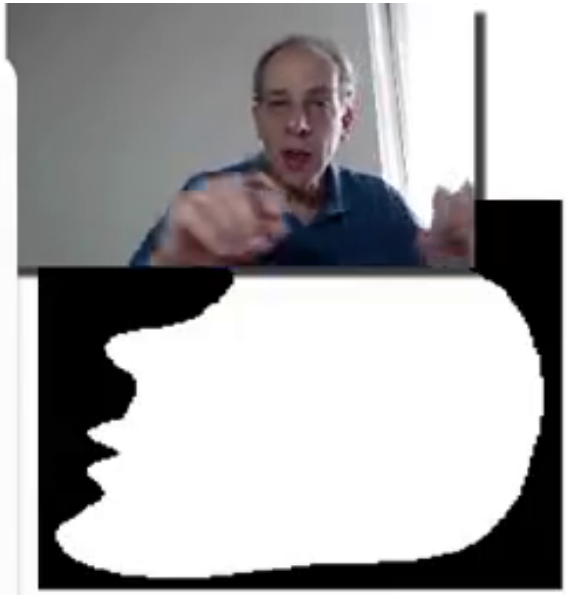
Geodesic Active Contours in 2D



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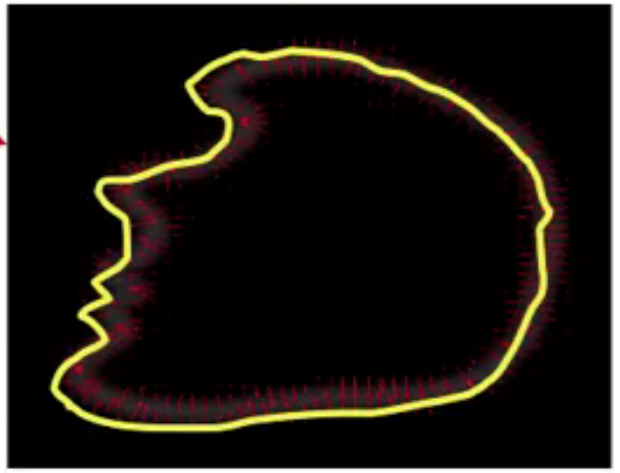

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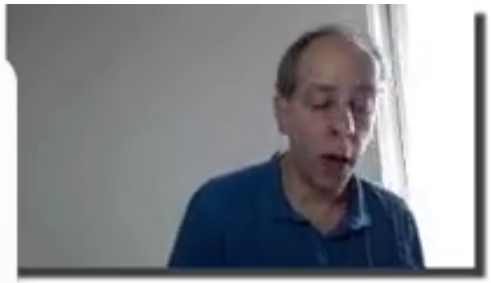
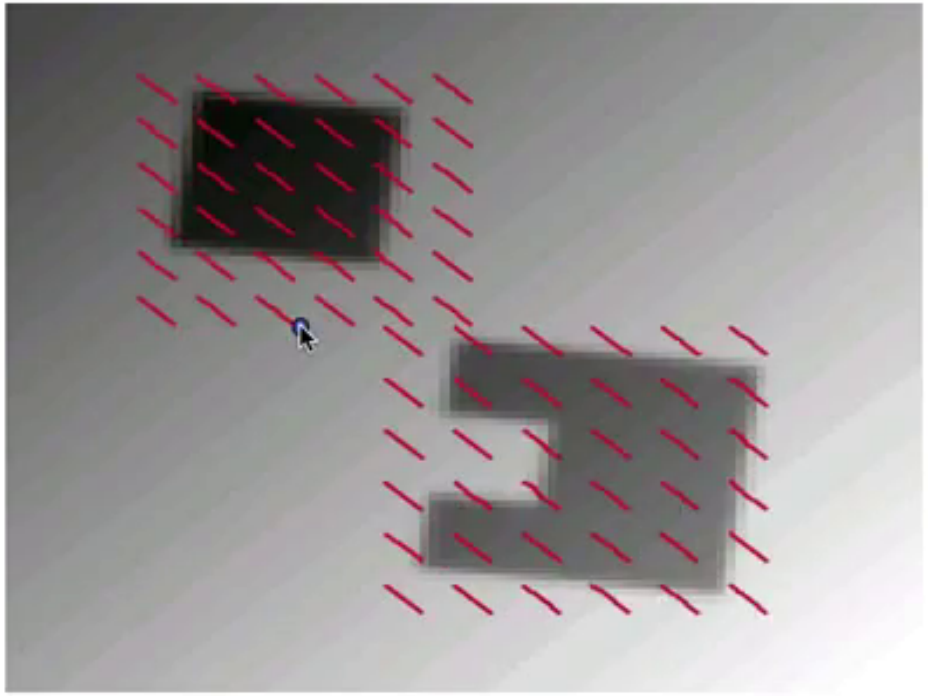
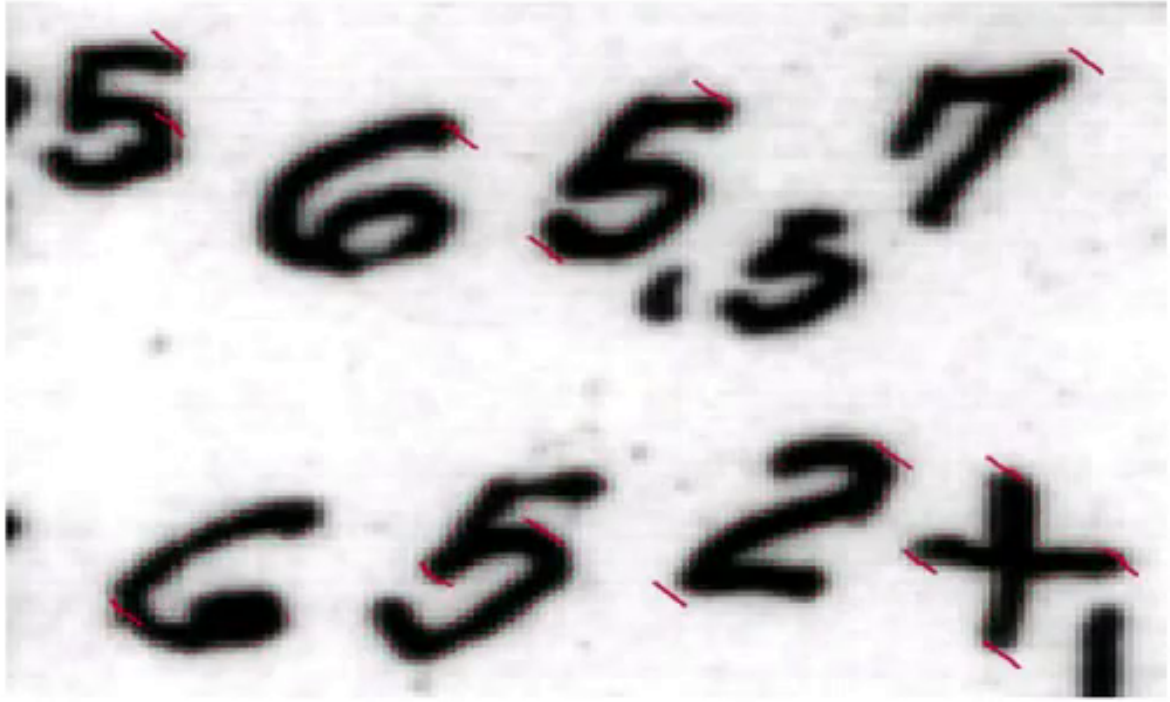
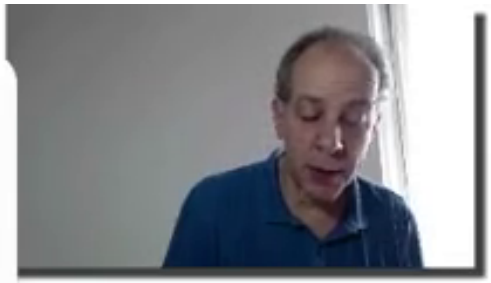
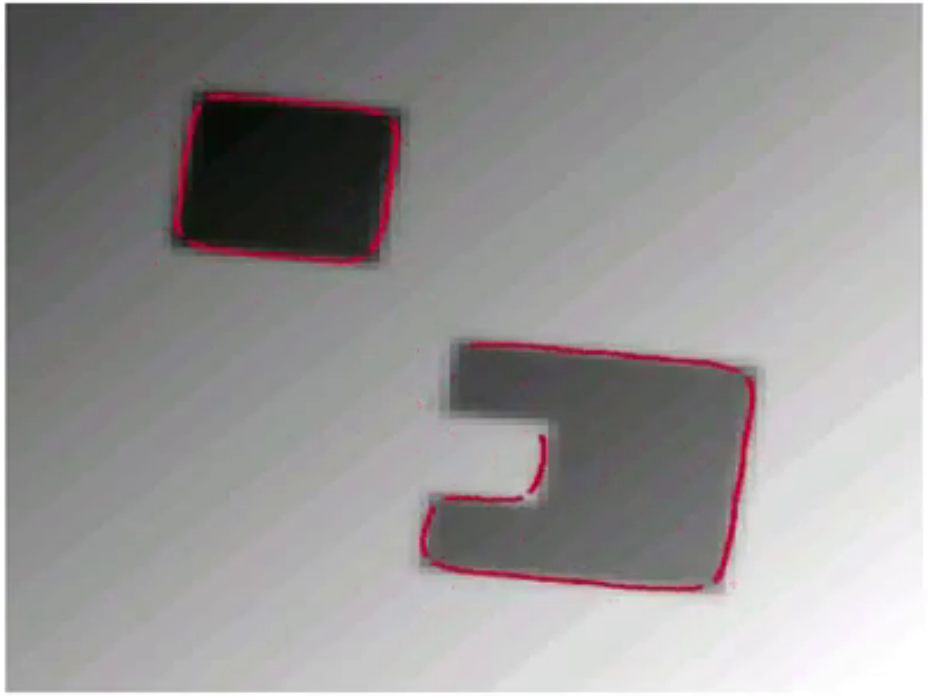


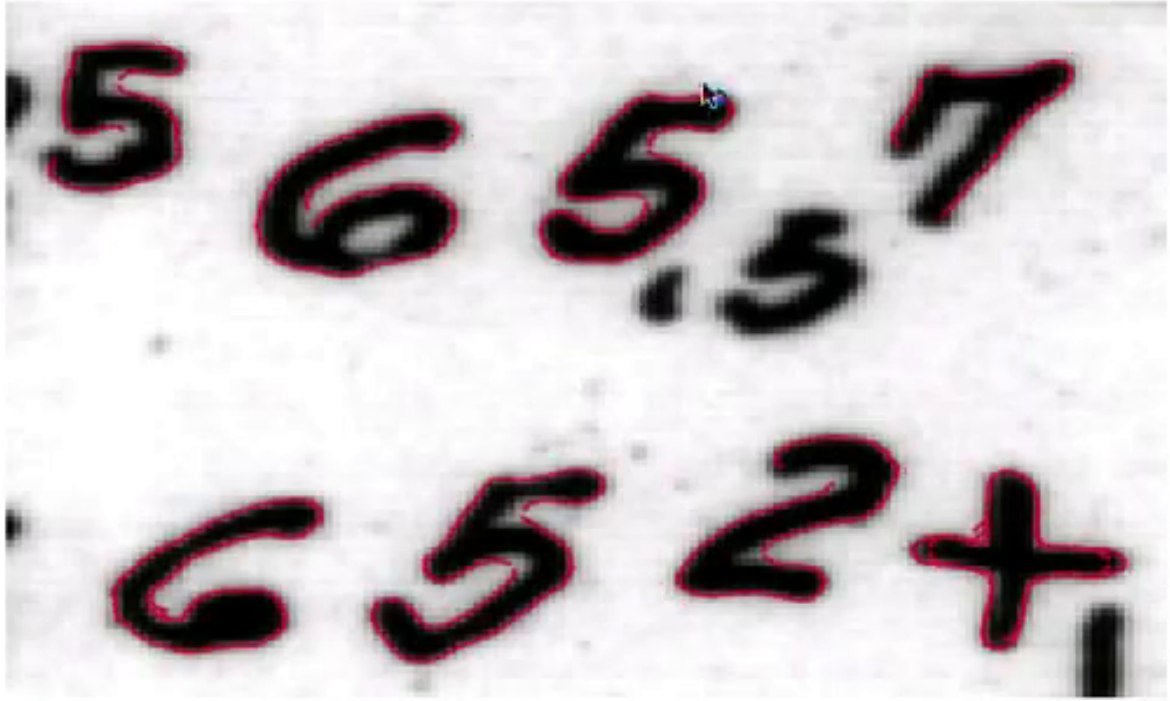




Images courtesy of Kimmel-Bruckstein







Images courtesy of Kimmel-Bruckstein

Gray Matter Segmentation

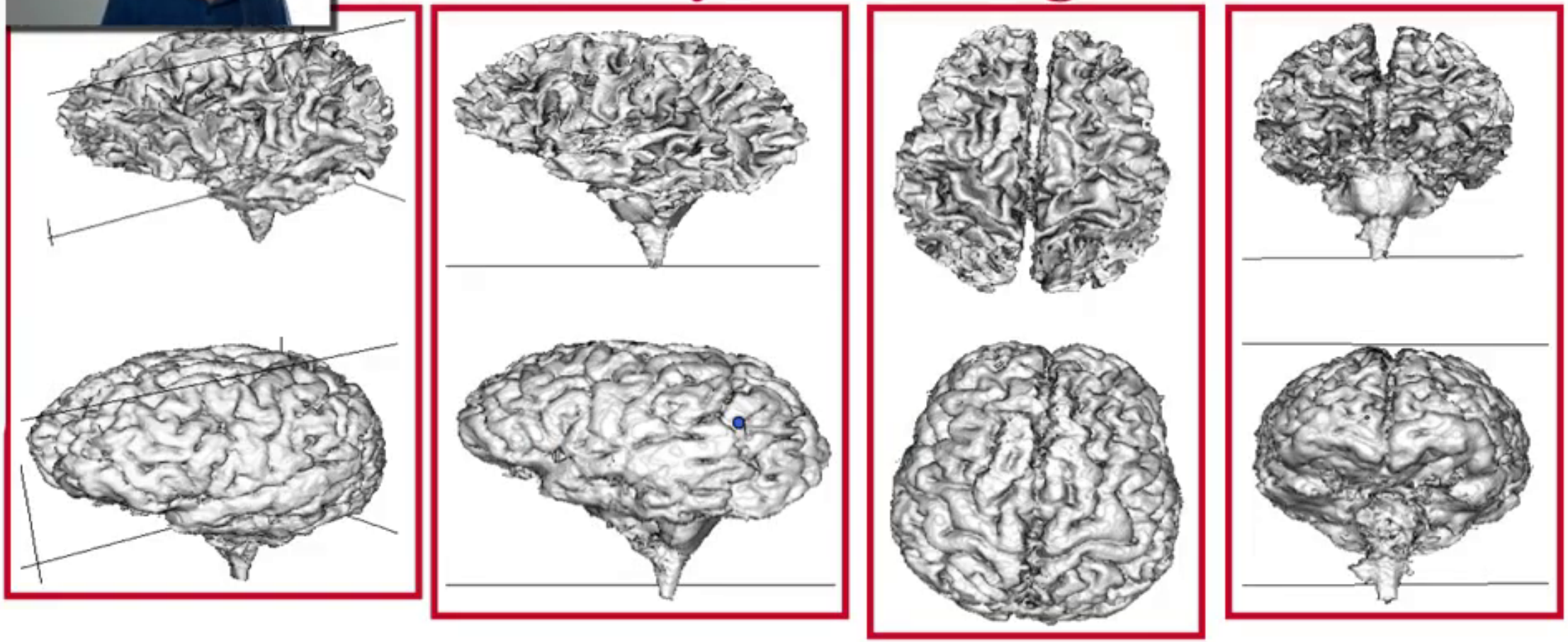
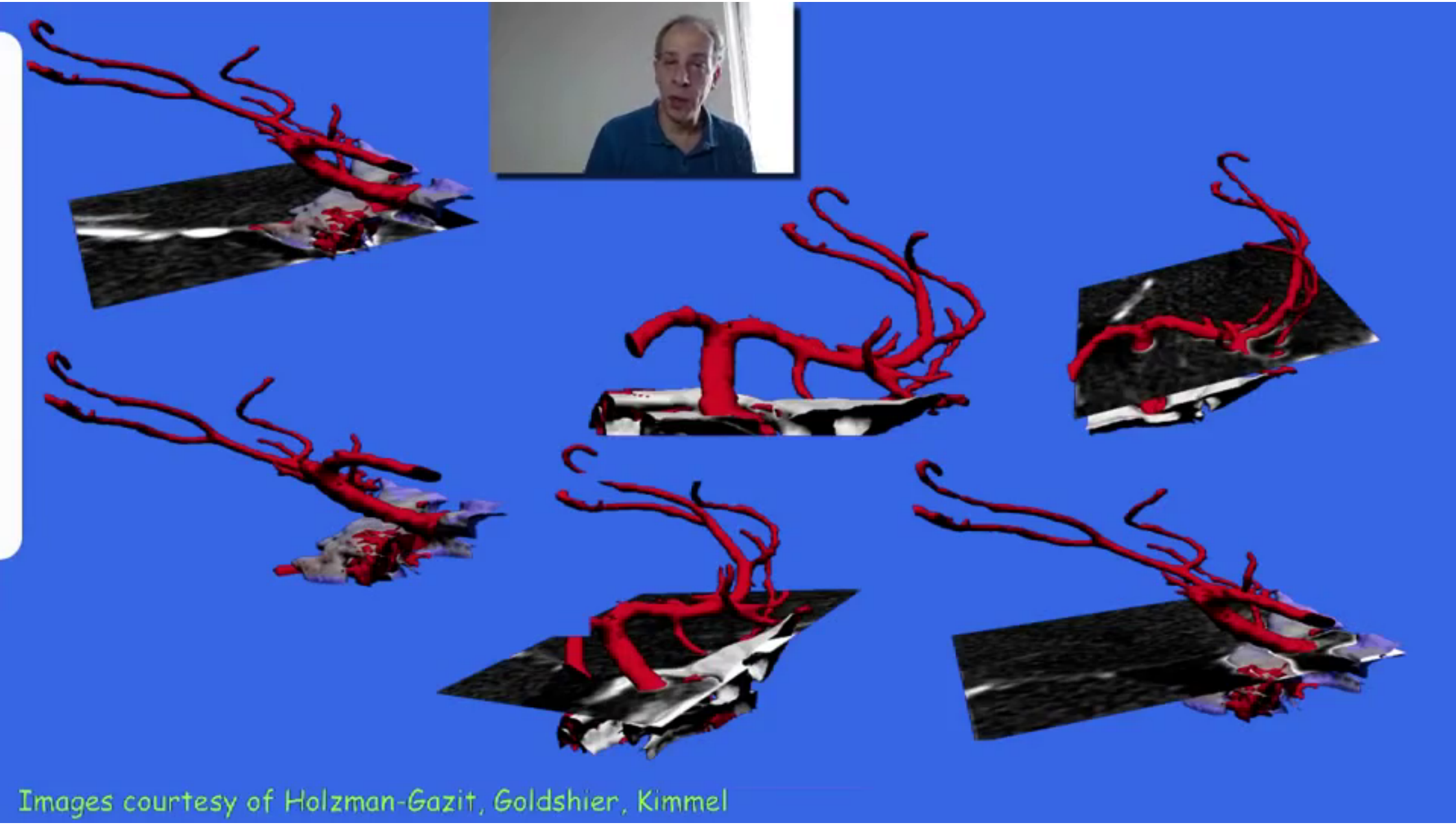


Image courtesy of Goldenberg Kimmel Rivlin Rudzsky,


Images courtesy of Holzman-Gazit, Goldshier, Kimmel