From Curves to Smoothing Filters

Embed initial curve as zero level set of surface:

$$C_0 = \{\Phi_0(x, y) = 0\}$$

Want evolution of surface to track motion of curve as zero level set:

$$C(t) = \{\Phi(x, y, t) = 0\}; \frac{\partial C}{\partial t} = \beta \vec{N} \Rightarrow$$

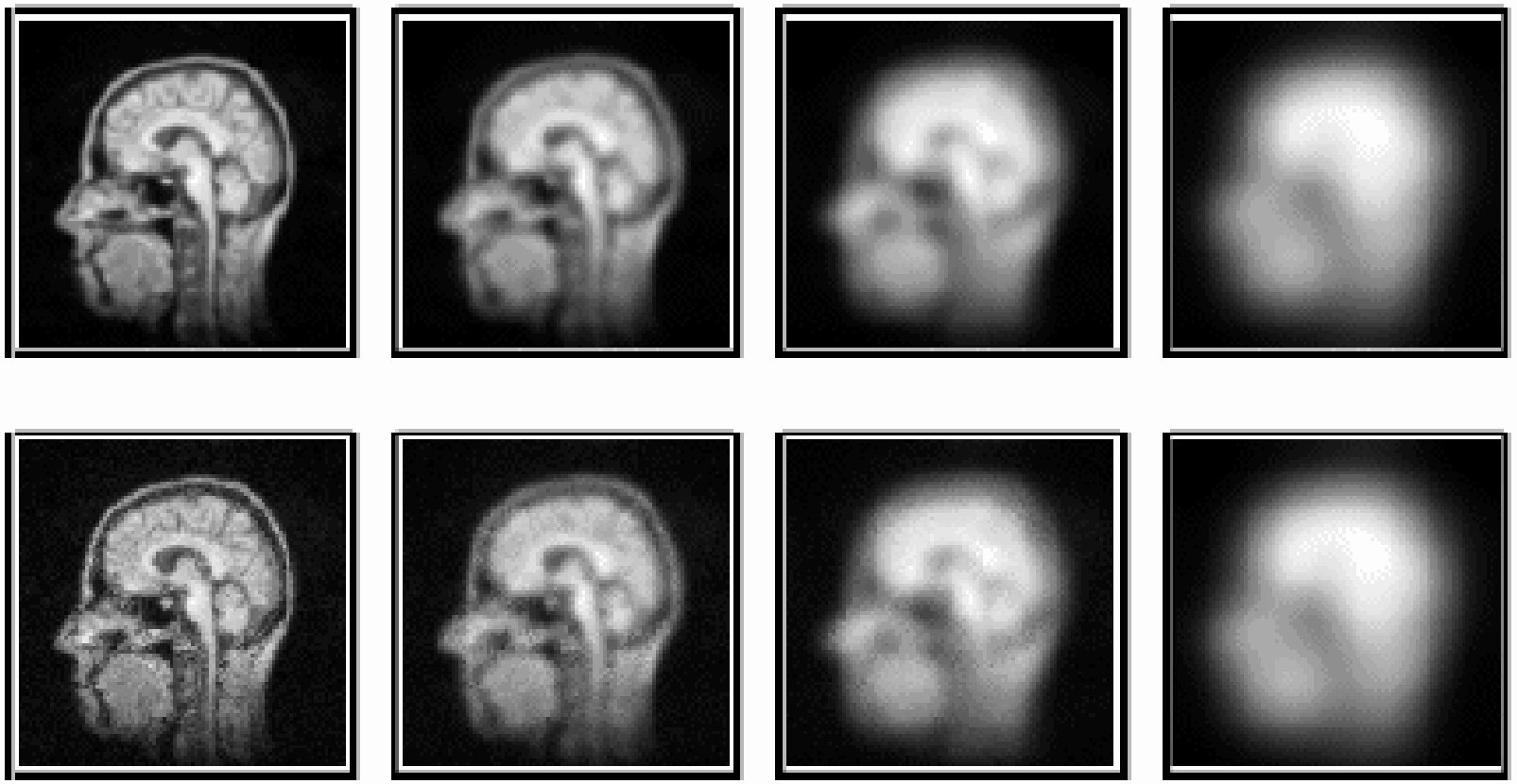
$$\Phi_t = \beta ||\nabla \Phi||$$

For affine geometric heat equation this leads to filter:

$$\Phi_t = (\Phi_{xx}\Phi_y^2 - 2\Phi_x\Phi_y\Phi_{xy} + \Phi_{yy}\Phi_x^2)^{1/3}$$

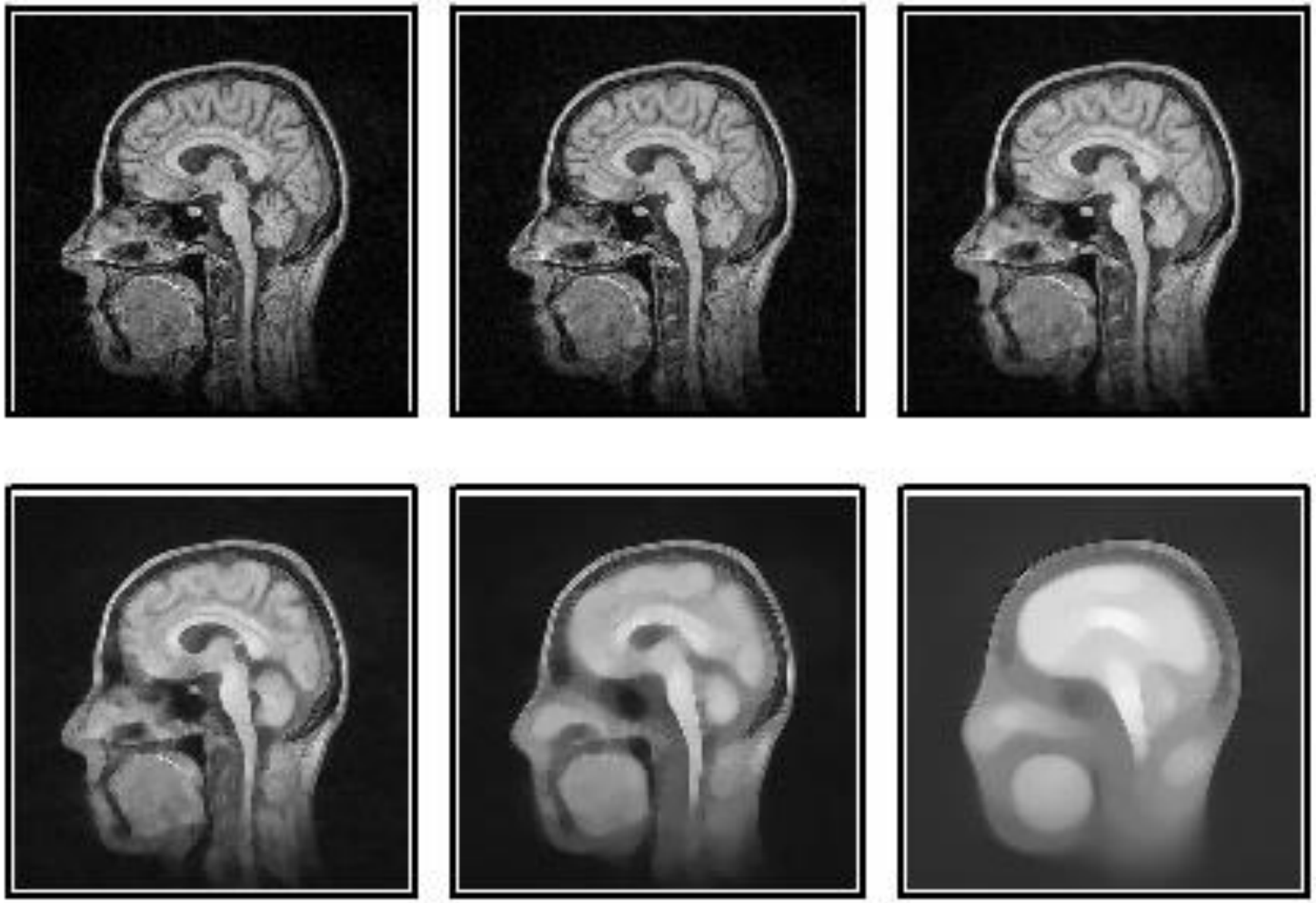
Here $\Phi_0 : \mathbf{R}^2 \rightarrow \mathbf{R}$ is interpreted as a gray-level image.

Smoothing with Linear Heat Equation



256 by 256 MRI brain image smoothed by linear heat equation: t=2, 6, 32, 128

Smoothing with Geometric Heat Equation

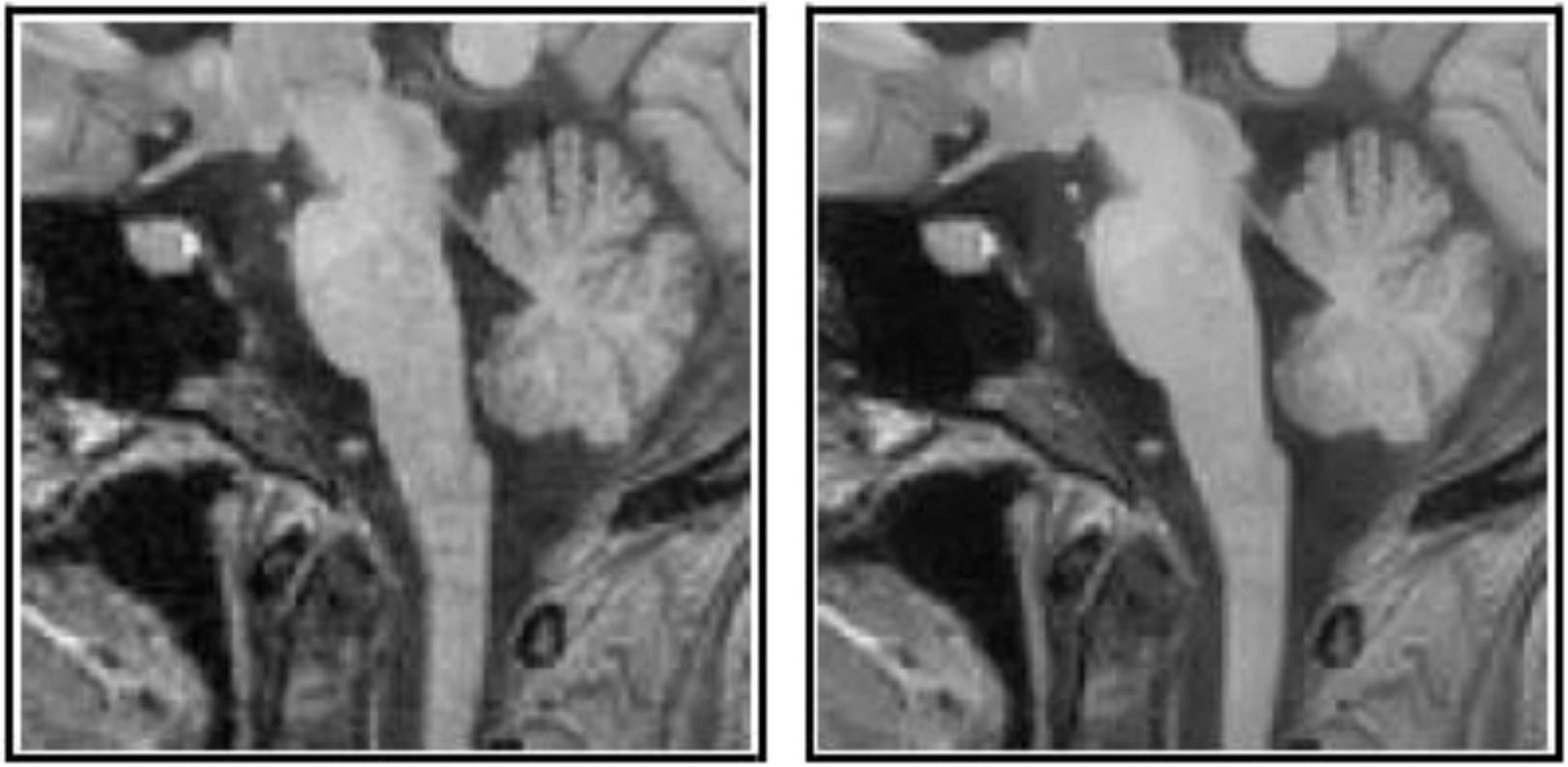


Smoothing with kappa filter: t=0, 4, 16, 64, 256, 1024

Smoothing with Affine Heat Equation-I

Smoothing with kappa-shleesh: t=0, 16, 128, 1024

Smoothing with Affine Heat Equation-II



Magnification of original image and image after 256 iterations of kappa-shleesh filter.