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COLLOQUIUM

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RESEARCH INTERESTS:

- 工程與科學上多尺度問題的模型和數值方法
- 偏微分方程的均勻化
- 數值分析
- 科學計算

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Volumetric variational principles to solve minimization problems and related PDE on surfaces

Abstract.
Partial differential equations on surfaces have wild applications in many areas, such as material science, surfactant problems, image processing and biology. These PDEs usually originate from minimizing energy functions defined on surfaces. This work targets applications that use implicit or non-parametric representations of closed surfaces or curves and require numerical solution for minimization problems defined on the surfaces.

In the previous work, we showed that the energy function defined on surfaces can be extended to the energy function defined on the nearby tubular neighborhood that gives the same energy when input the constant-along-normal extension. Furthermore, the extended energy function gives the same minimizer as which the original energy function gives in the sense of restriction on the surface. This new approach connects the original energy function to an extended energy function and provides a good framework to solve PEDs numerically on Cartesian grids. In this talk, we continue the results in previous work to develop a framework to solve more challenging problems defined on surfaces, such as nonlinear and non-convex energy problems. We propose a direct approach to solve the minimization problems. Instead of deriving Euler-Lagrange, we discretize the energy functions on Cartesian grids, then find the minimizer of the discrete energy function. The advantages of this approach include: more compact stencils, easy to implement and be able to combine with modern techniques on nonlinear/non-convex optimizations. We demonstrate that our method can be applied successfully on the TV-denoising and obstacle problems defined on surfaces.