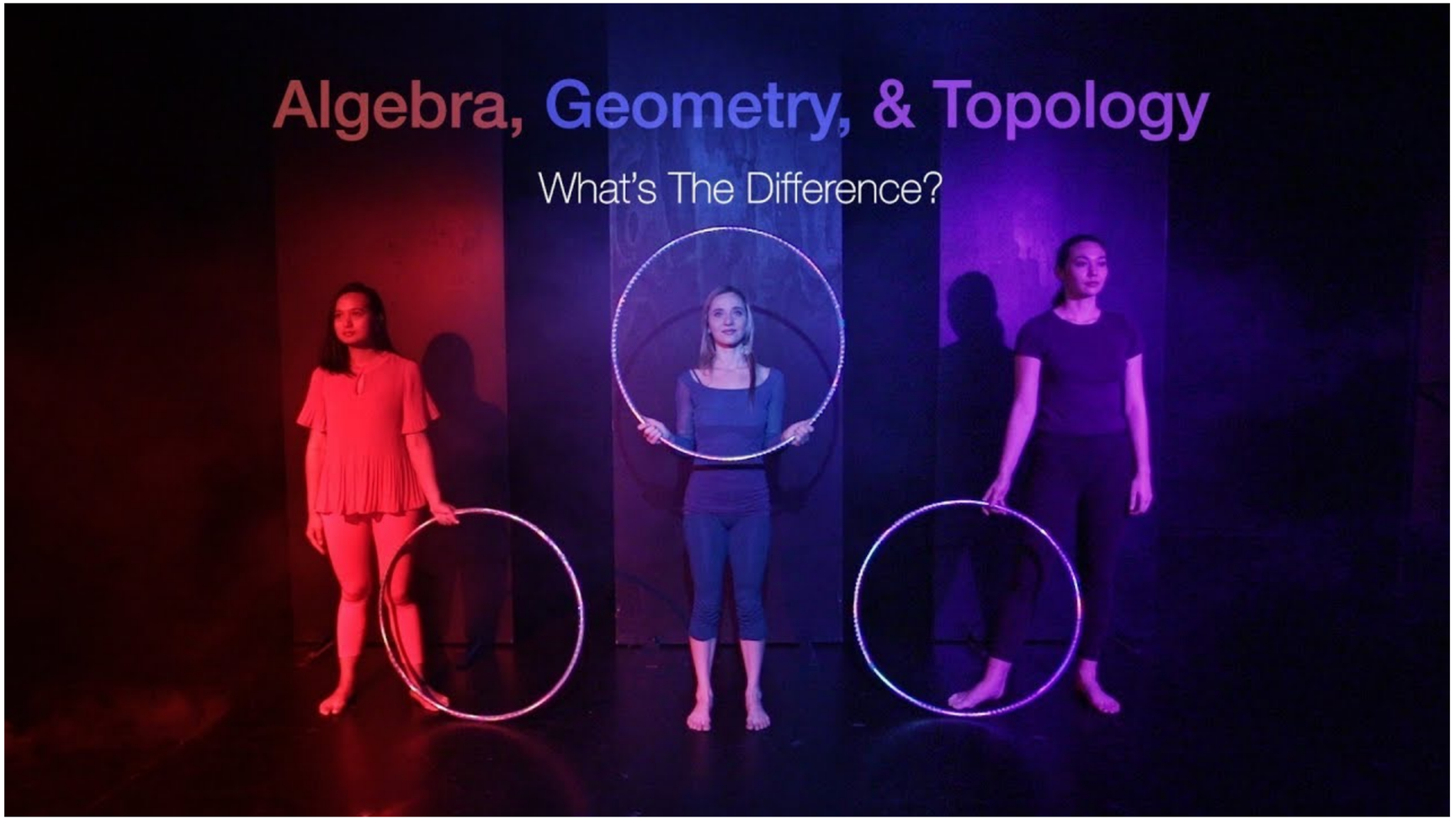
Is there math after calculus?



Written and created by Dr. Scherich

https://www.youtube.com/watch?v=xgKc7dFz-ko

Video Interviews - Connections

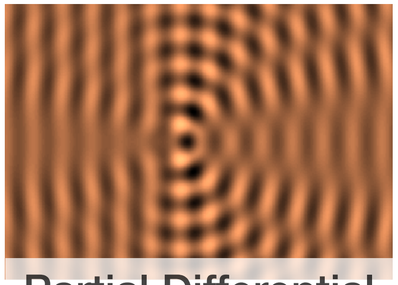
click to watch click to watch click to watch click to watch click to watch click to watch click to watch click to watch

Dr. Lauren Ancel Meyers Biology, Statistics, Data Science	Dr. Lyla El-Fayomi Neuroscience	Nick Fellini Mathematics
Dr. Anna Goldenberg Machine Learning for Health	Dr. Mjaye Mazwi Pediatric Critical Care	Dr. Nicole Mideo Ecology and Evolutionary Biology
Rebecca Moranis Music Theory	Dr. Abe Pressman Biochemist	Dr. Elizabeth Wong Paediatric Pharmacist

click to watch click to watch click to watch click to watch click to watch click to watch click to watch click to watch

Quercus > Modules > Reading Week

Teaching Team

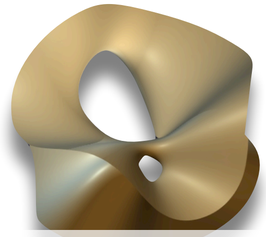


Partial Differential Equations

Afiny Akdemir
Sebastian Gherghe

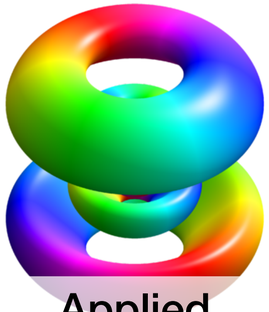
Differential Geometry

Gavin Hurd



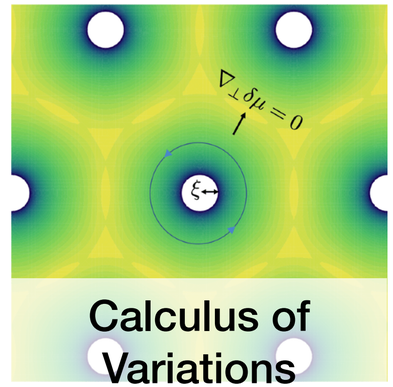
Algebraic Geometry

Soheil Memarian Sorkhabi



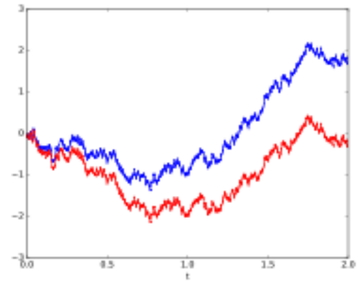
Applied Probability

Dmitry Panchenko



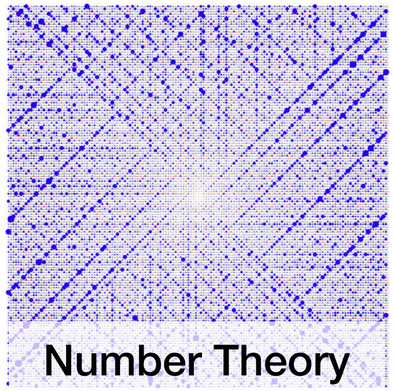
Calculus of Variations

Bernardo Galvão-Sousa



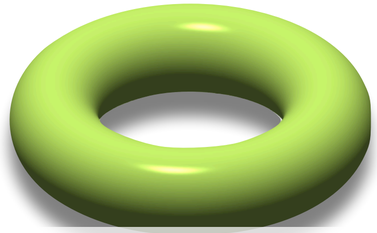
Stochastics

Virginia Pedreira



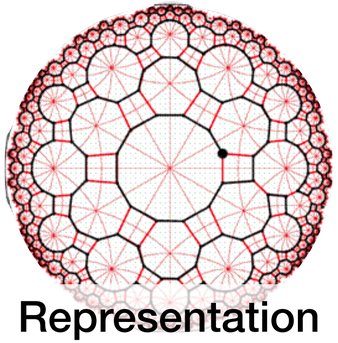
Number Theory

Erik Holmes



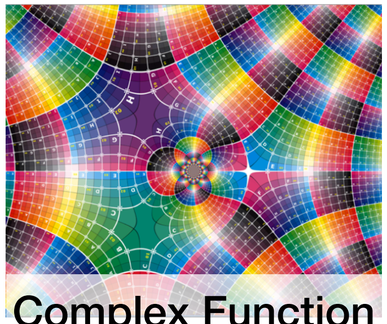
Geometric Topology

Aleksandr Berdnikov
Clovis Hamel



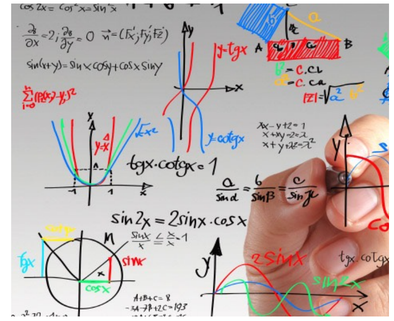
Representation Theory

William Sokurski



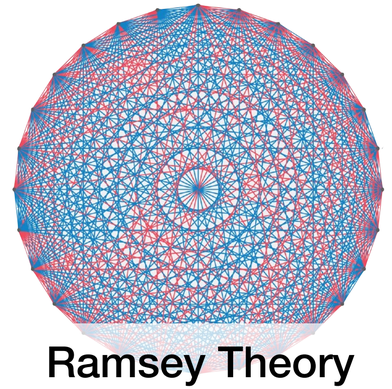
Complex Function Theory

Emile LeBlanc



Math Education

Bernardo Galvão-Sousa



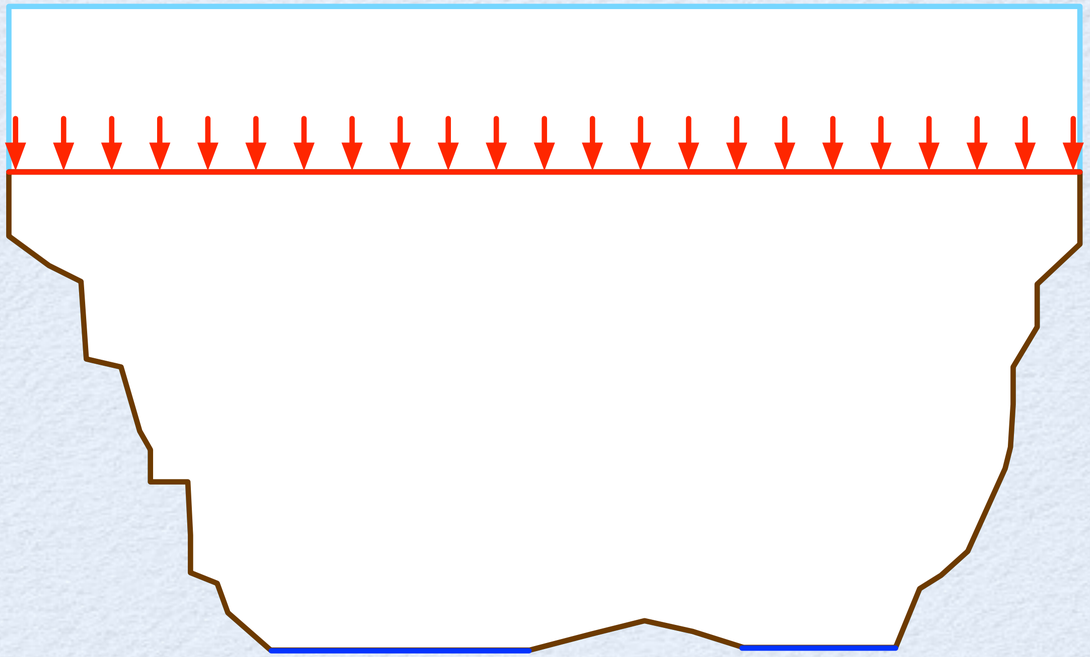
Ramsey Theory

Jamal Kawach

Fall 2023

MAT135 Calculus 1

structural optimization

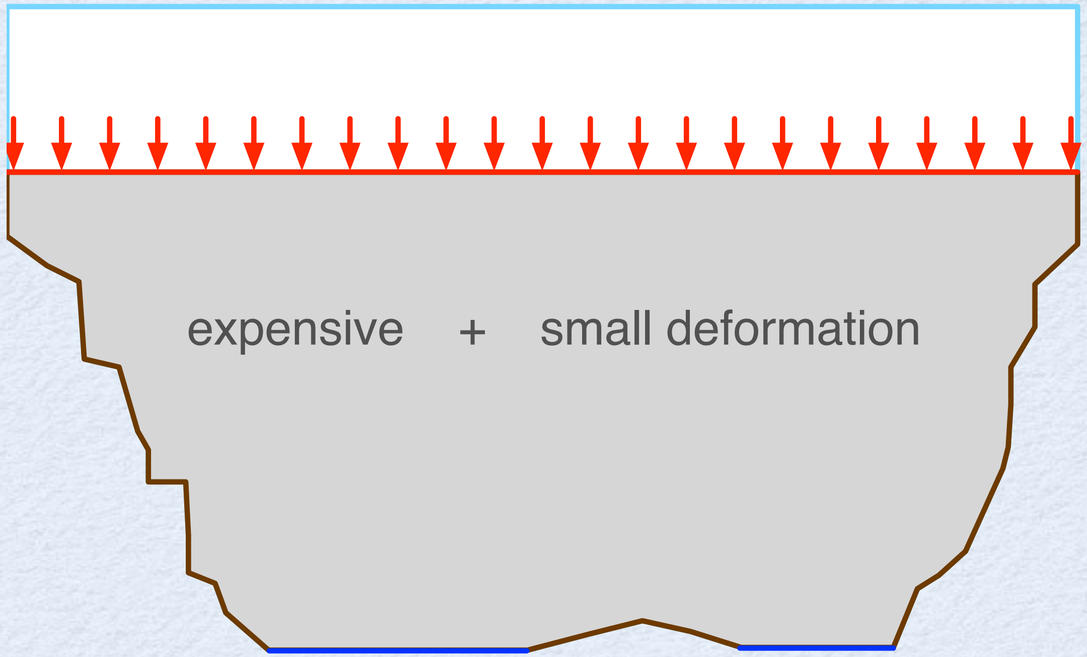


structural optimization

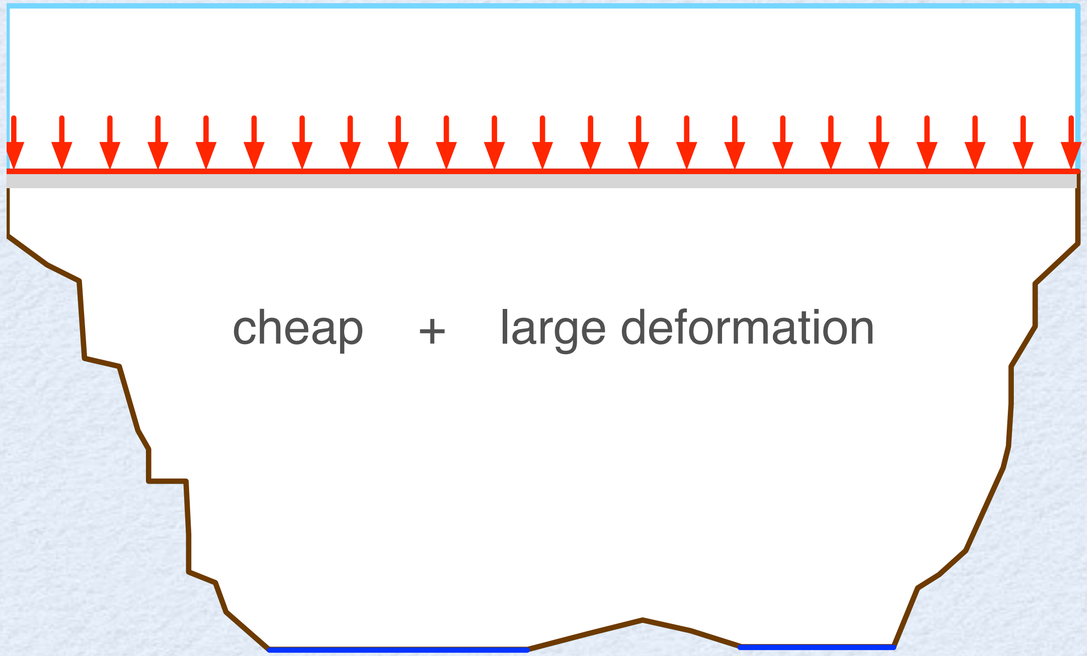
minimize

cost of material + deformations

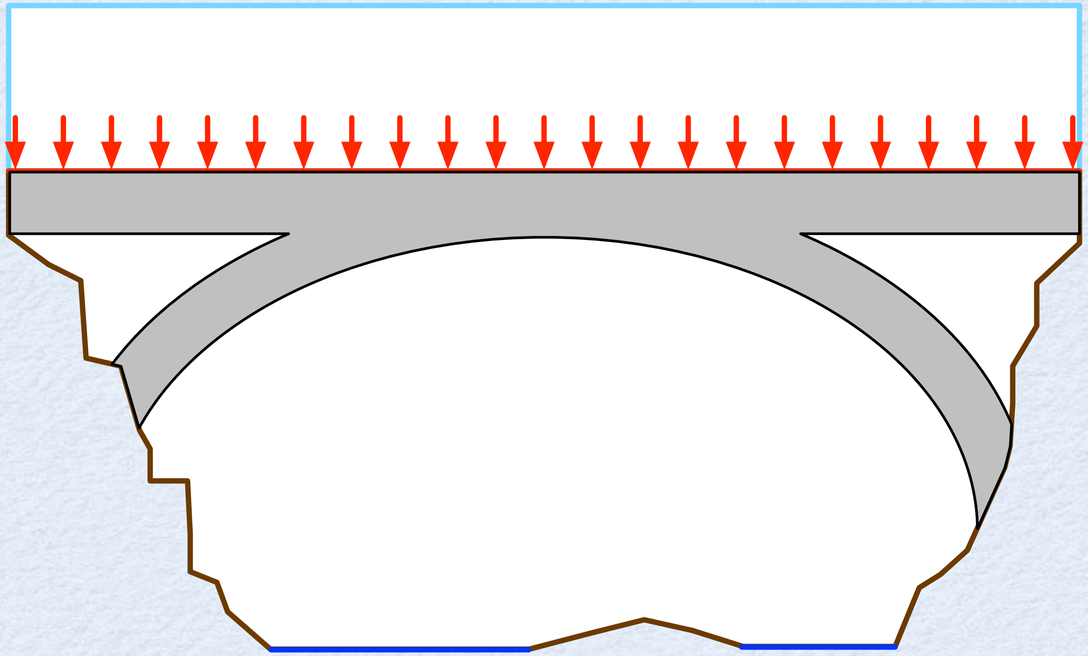
structural optimization



structural optimization

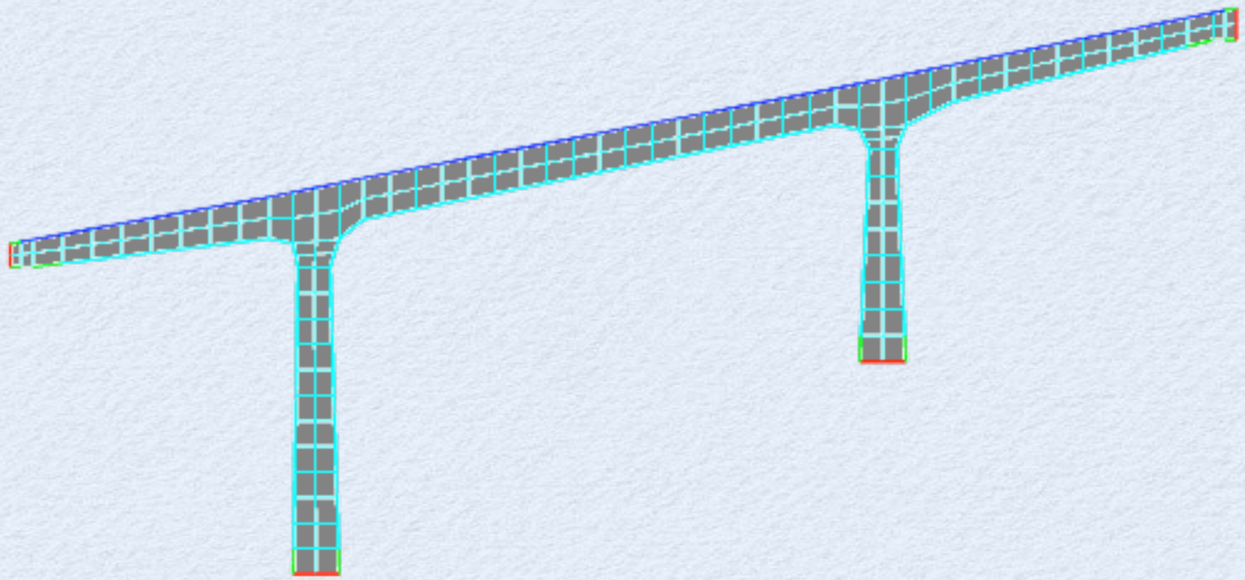


structural optimization



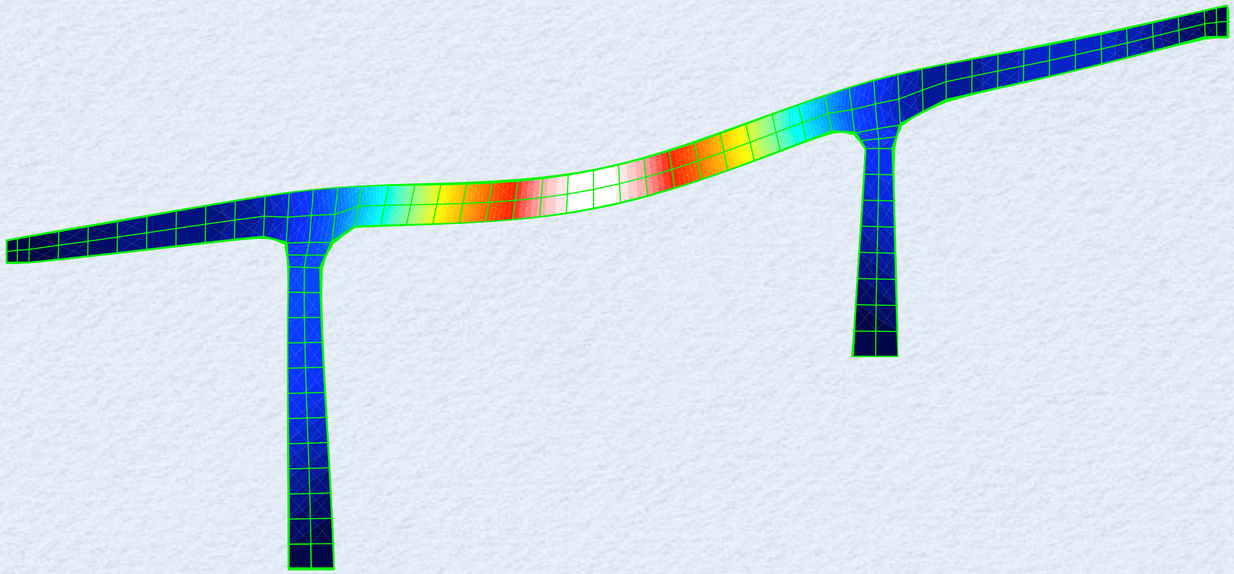
structural optimization

step 1. figure out how structures deform



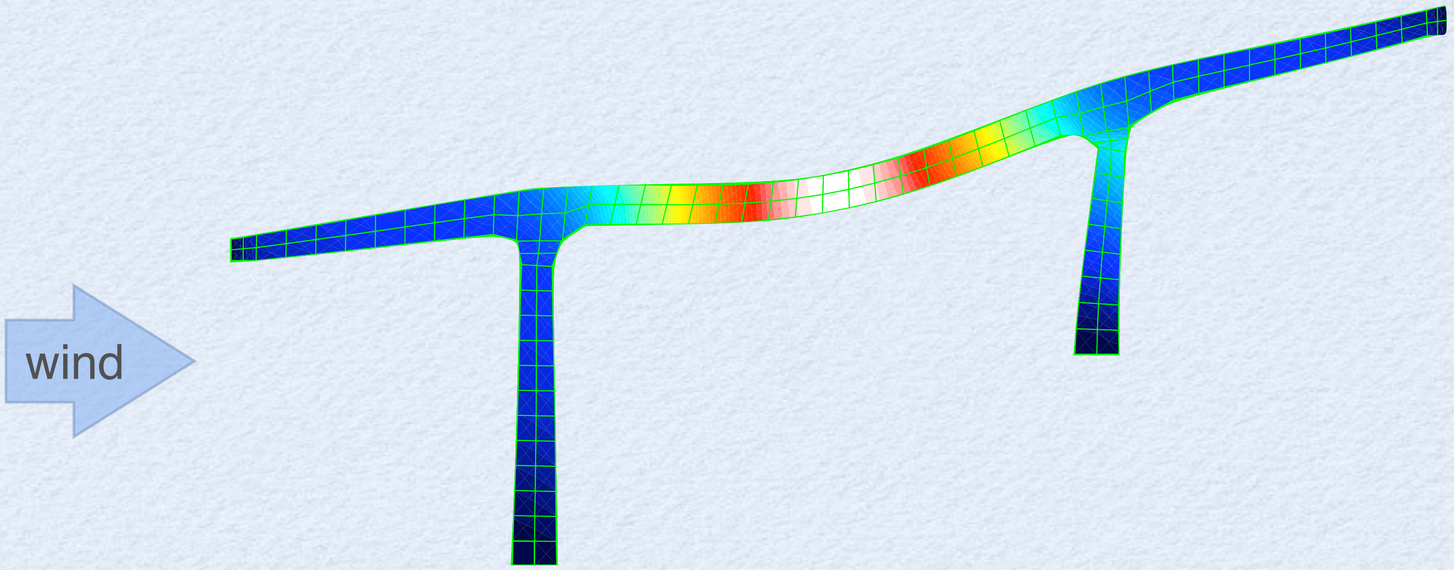
structural optimization

step 1. figure out how structures deform



structural optimization

step 1. figure out how structures deform



structural optimization

step 1. figure out how structures deform

linearized elasticity equation

u dislocation from initial position

$$u = 0 \quad \text{on} \quad \Gamma_d$$

$$\int_\Omega E^H_{\alpha\beta\gamma\delta}\, e_{\gamma\delta}(u)\, e_{\alpha\beta}(v)\, dx = \int_\Omega f_\alpha\, v_\alpha\, dx + \int_{\Gamma_t} g_\alpha v_\alpha\, dS$$

for all $v = 0$ on Γ_d

structural optimization

step 2. figure out how to measure cost of material

work to build structure

$$k \int_\Omega \rho \, dx$$

structural optimization

step 3. goal

minimize
u, ρ

$$\int_\Omega f_\alpha \, u_\alpha \, dx + \int_{\Gamma_t} g_\alpha u_\alpha \, dS + k \int_\Omega \rho \, dx$$

where u solves

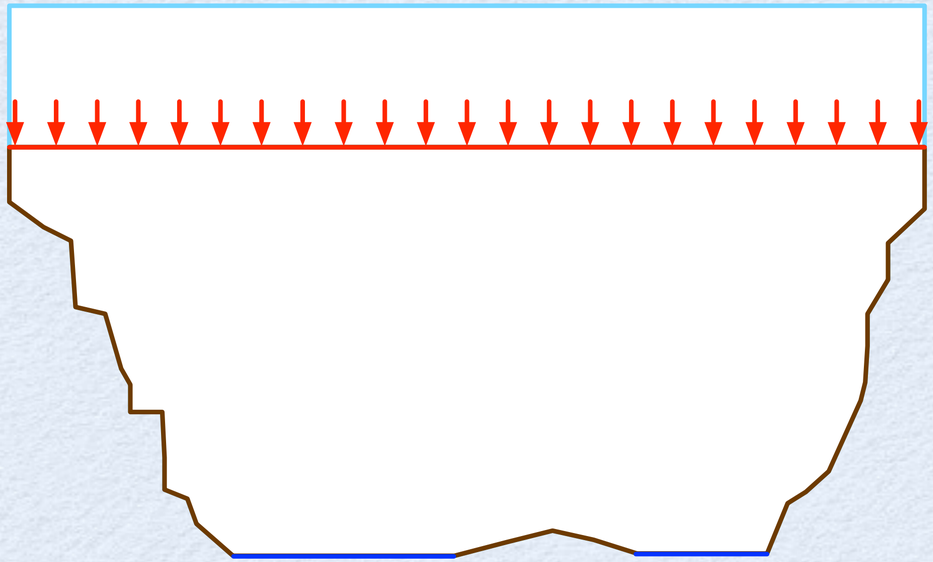
$$u = 0 \quad \text{on} \quad \Gamma_d$$

$$\int_\Omega E_{\alpha\beta\gamma\delta}(\rho) \, e_{\gamma\delta}(u) \, e_{\alpha\beta}(v) \, dx = \int_\Omega f_\alpha \, v_\alpha \, dx + \int_{\Gamma_t} g_\alpha v_\alpha \, dS$$

for all $v = 0$ on Γ_d

structural optimization

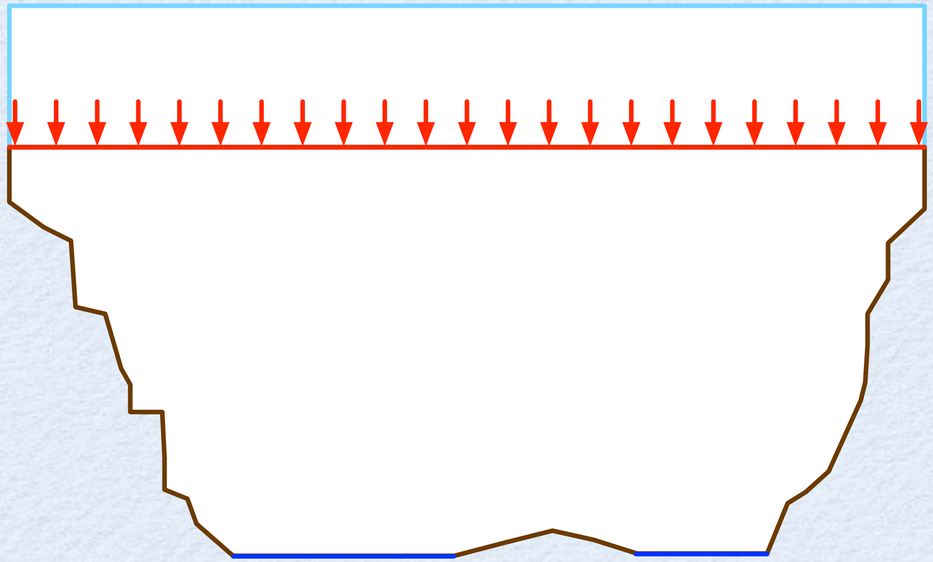
step 4. numerical approximation of solution



structural optimization

step 4. numerical approximation of solution

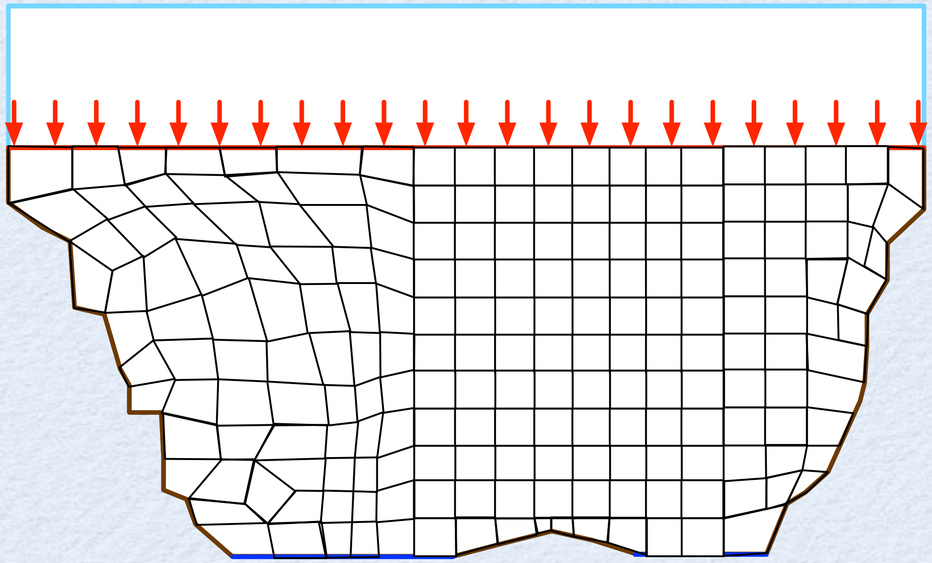
step 4a. divide the domain in four-sided polygons



structural optimization

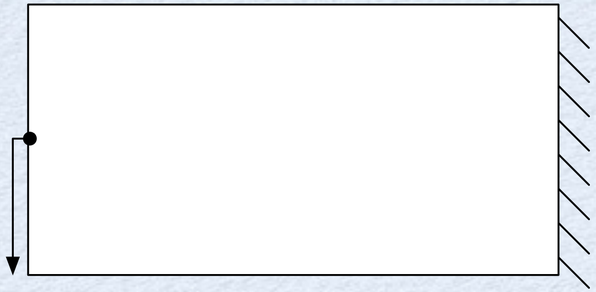
step 4. numerical approximation of solution

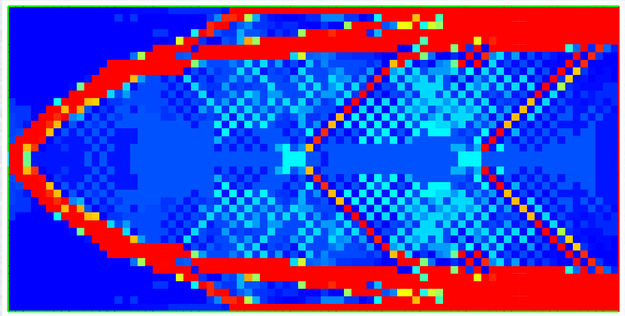
step 4a. divide the domain in four-sided polygons

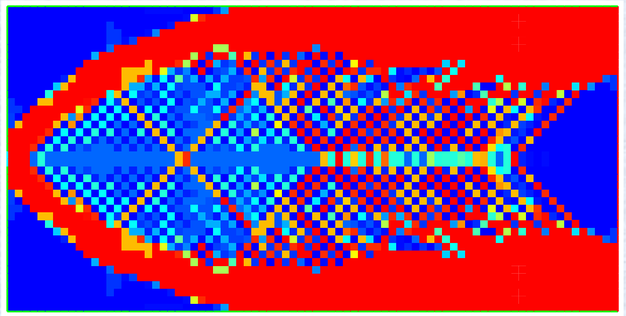


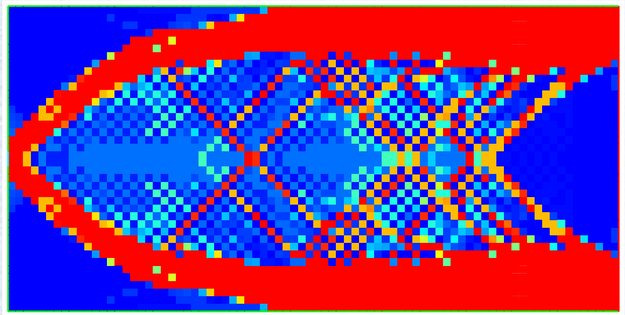
structural optimization

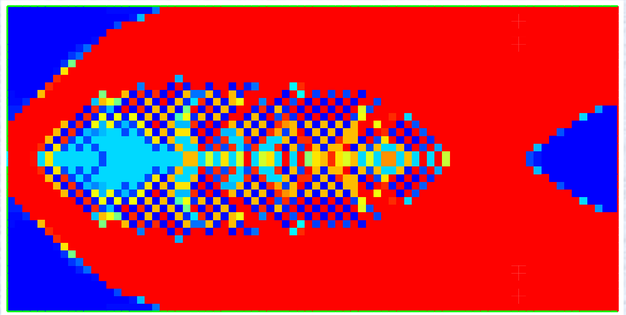
example 1





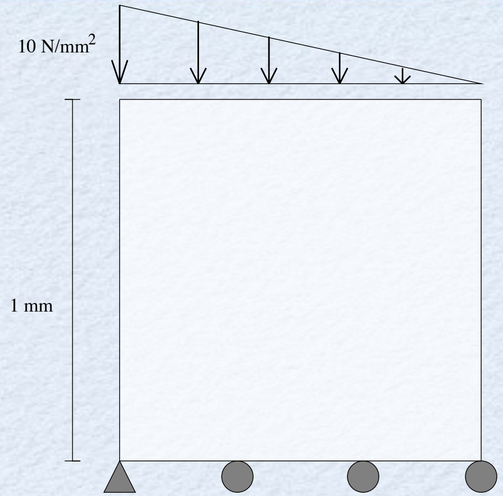


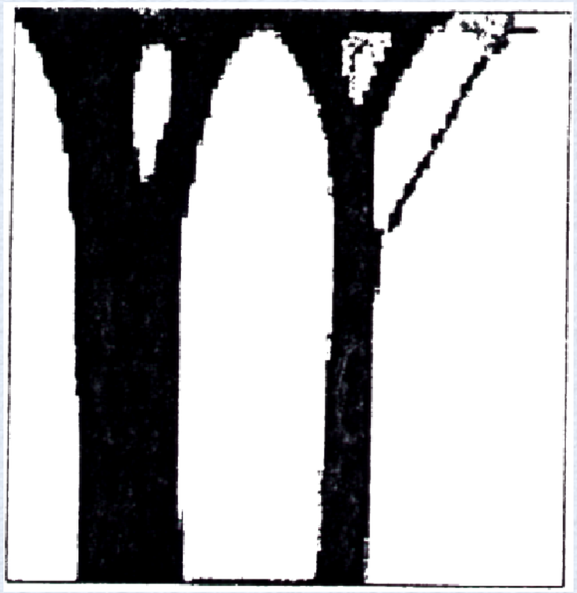


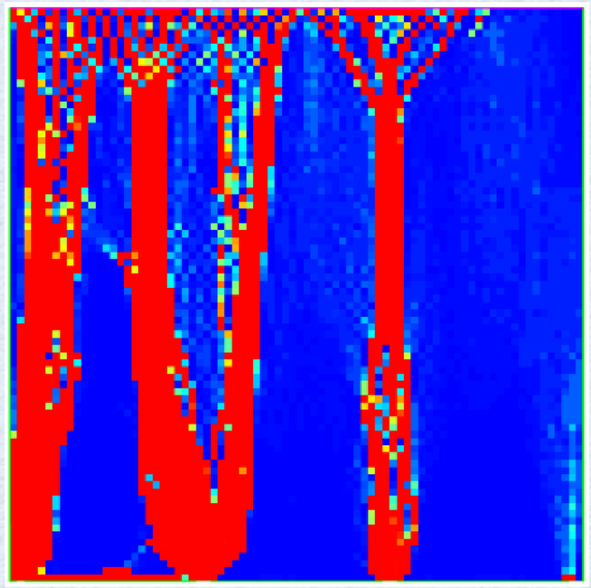


structural optimization

example 2

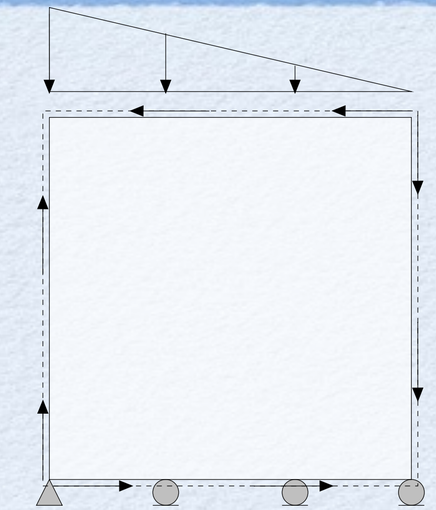


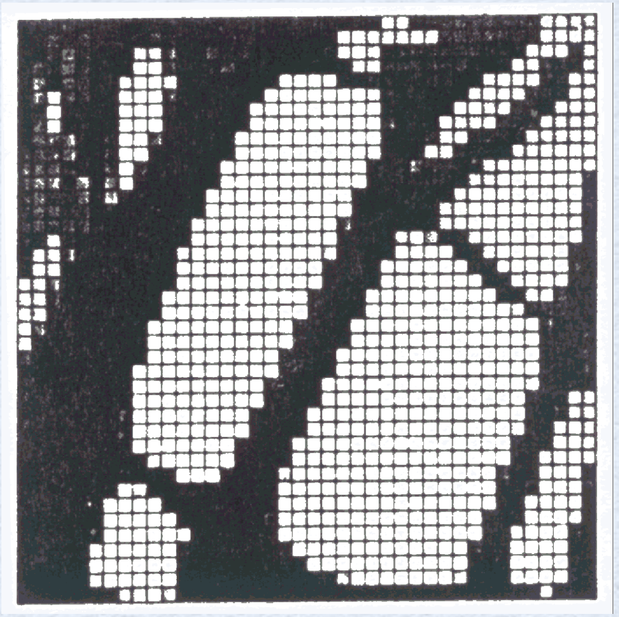


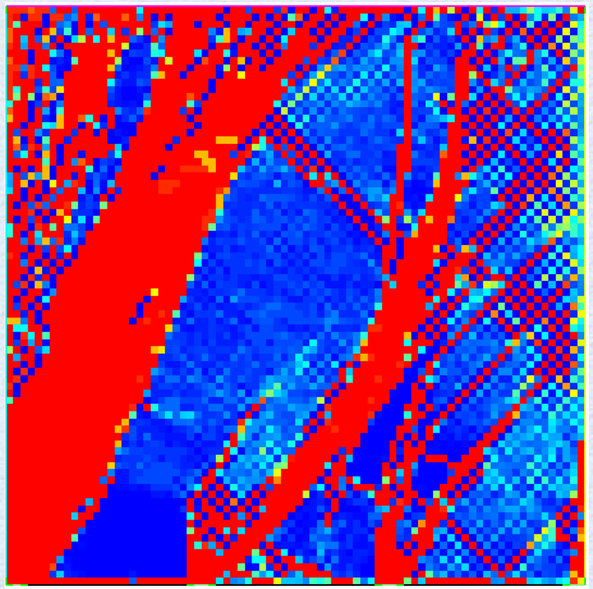


structural optimization

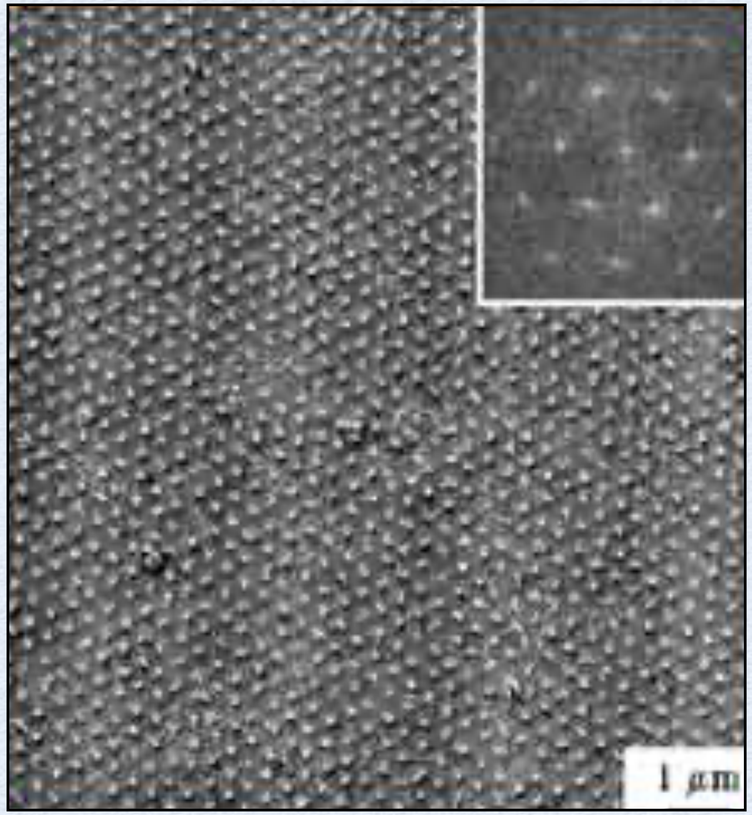
example 3

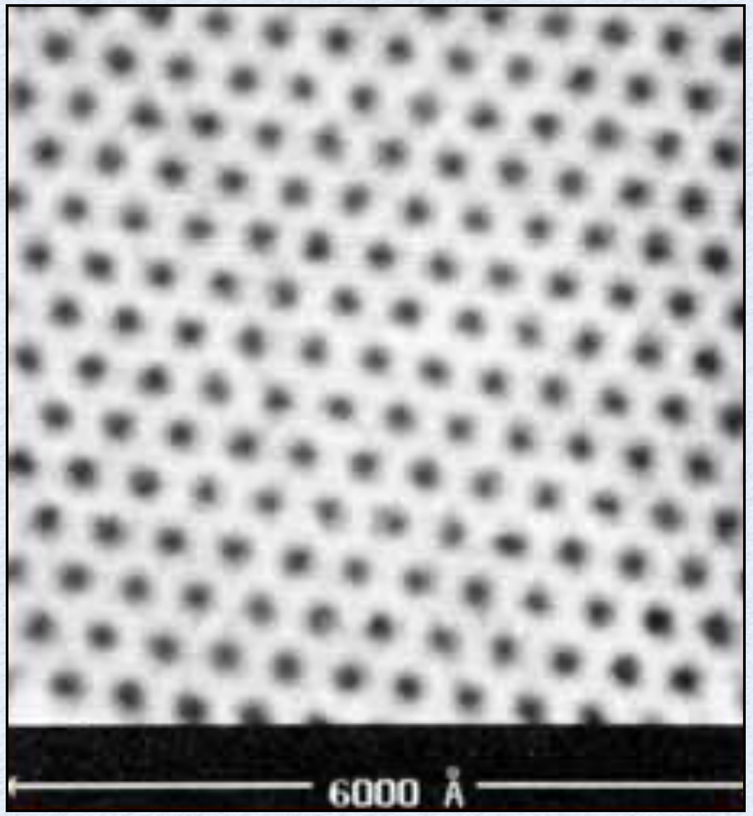


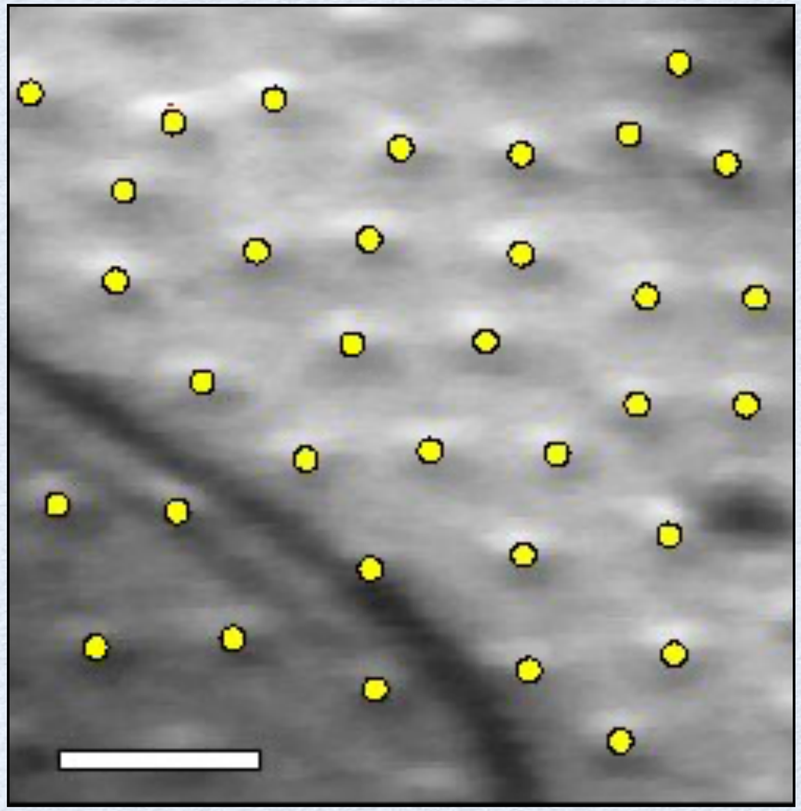




superconducting materials







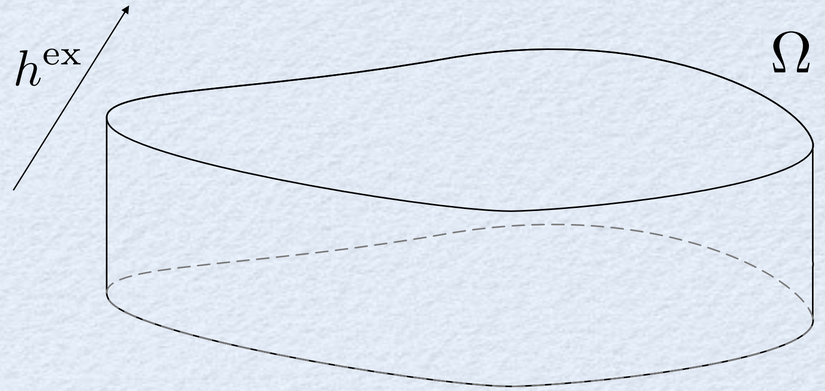
superconducting materials

u complex order parameter

A electromagnetic vector potential

$h = \nabla \times A$ induced magnetic field

$h^{\mathrm{ex}} = \nabla \times A^{\mathrm{ex}}$ external magnetic field



$$\min_{(u,A)} \left[\frac{1}{2} \int_{\Omega} \left(\left| (\nabla - iA)u \right|^2 + \frac{\kappa^2}{2} \left(1 - |u|^2 \right)^2 \right) dx + \frac{1}{2} \int_{\mathbb{R}^3} |h - h^{\mathrm{ex}}|^2 \, dx \right]$$

superconducting materials

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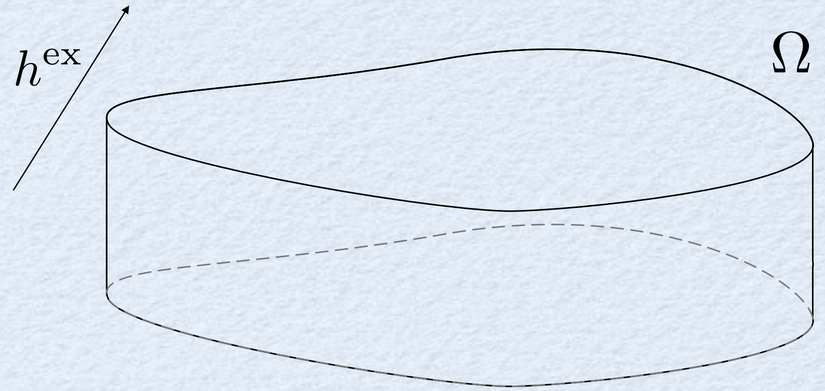

$$\min_{(u,A)} \left[\frac{1}{2} \int_{\Omega} \left(\left| (\nabla - iA)u \right|^2 + \frac{\kappa^2}{2} \left(1 - |u|^2 \right)^2 \right) dx + \frac{1}{2} \int_{\mathbb{R}^3} |h - h^{\mathrm{ex}}|^2 \, dx \right]$$

$$h \approx h^{\mathrm{ex}}$$

superconducting materials

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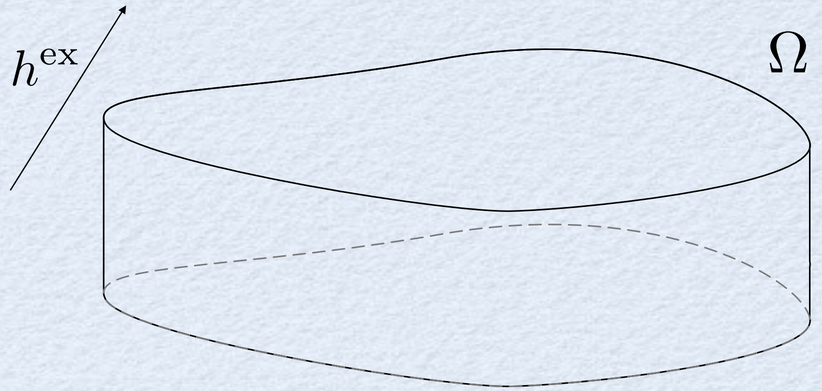

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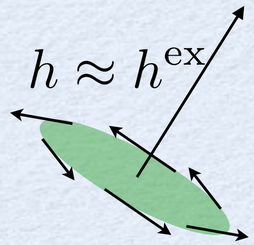

superconducting materials

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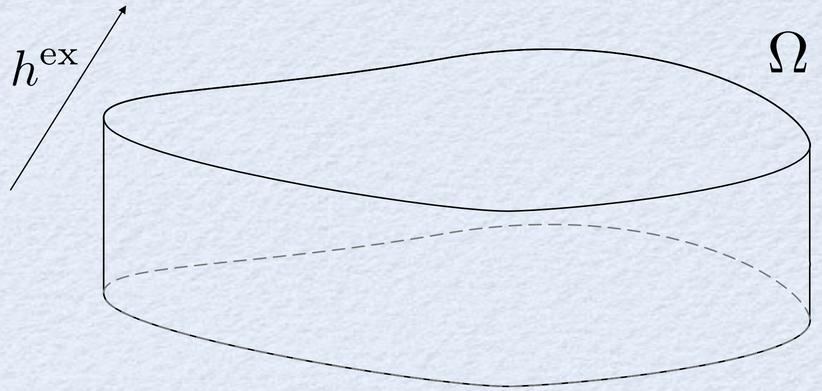

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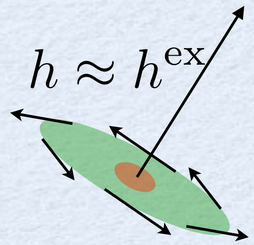

superconducting materials

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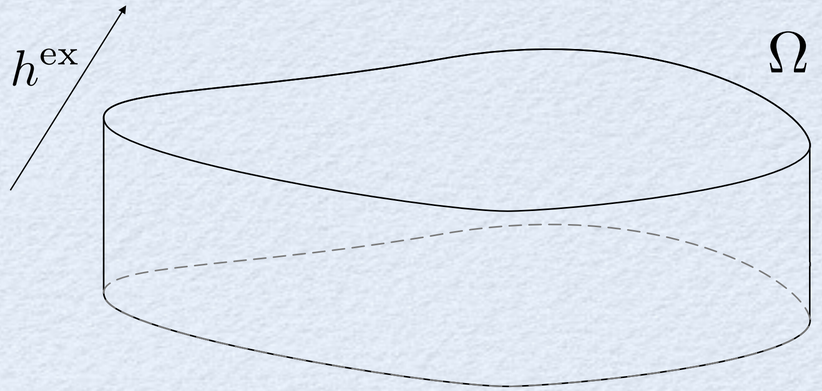

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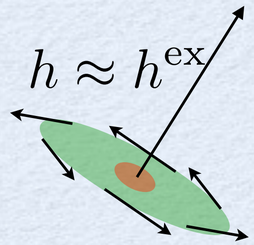
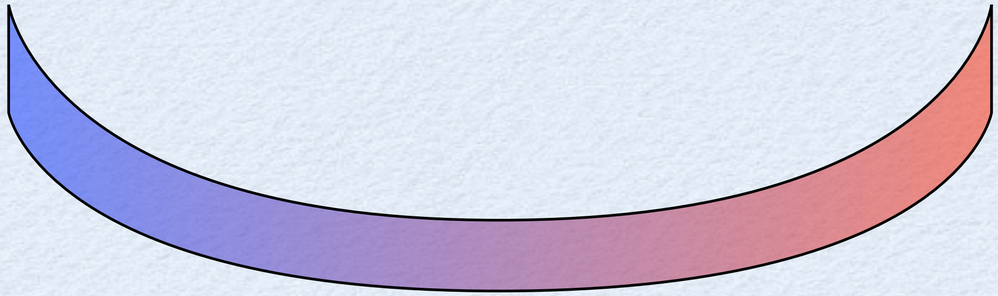


vortices

superconducting materials



superconducting materials