Discrete and continuous models for connectivity constraints in topology optimization

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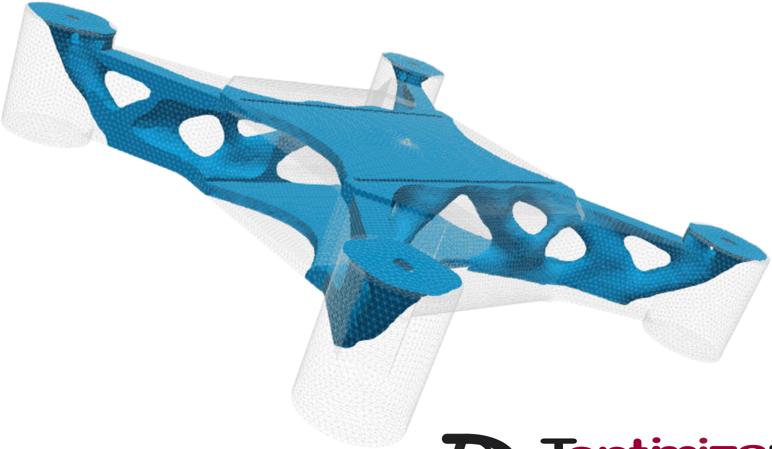
Departamento de Matemáticas (UCLM)

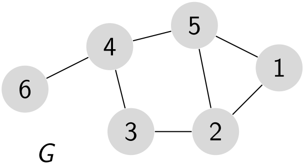
Red COPI2A (Sevilla, 17 de enero, 2024)

Topology optimization



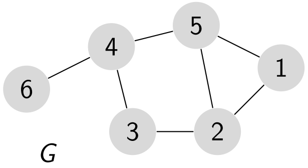
Toptimiz3D
Better designs

A discrete approach based on graph theory



$\Longrightarrow \quad \mathcal{L}(G)$

A discrete approach based on graph theory



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- The **algebraic connectivity** is the second-smallest eigenvalue λ_2 of $\mathcal{L}$: a measure of how well connected the overall graph G is.

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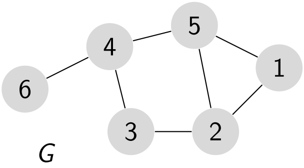

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- The multiplicity of the null eigenvalue coincides with the number of connected components in G (i.e., $\lambda_2 > 0 \Longleftrightarrow G$ is connected).

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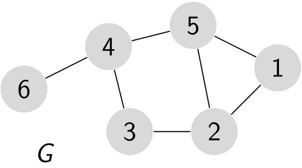

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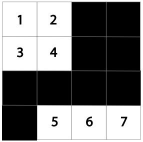
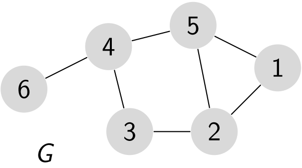


0/1 structure

A discrete approach based on graph theory



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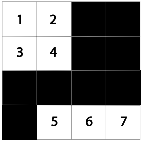

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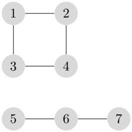
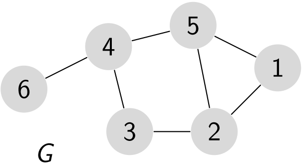


Void graphs

A discrete approach based on graph theory



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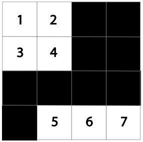

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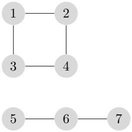

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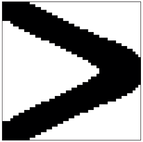

$\lambda_3^{\text{Void}} = 0$

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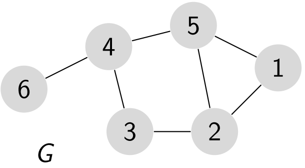

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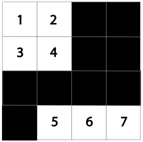

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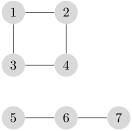

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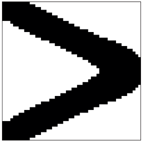

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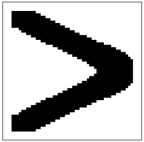
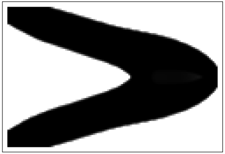


$\lambda_2^{\text{Void}} > 0$

STRUCTURAL DESIGN

$\lambda_8^{\text{Void}} = 0$



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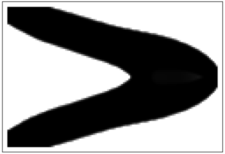

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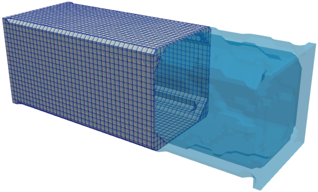

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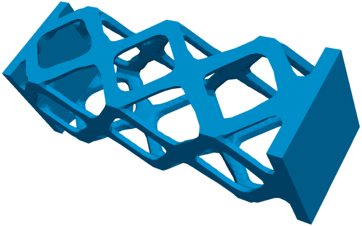

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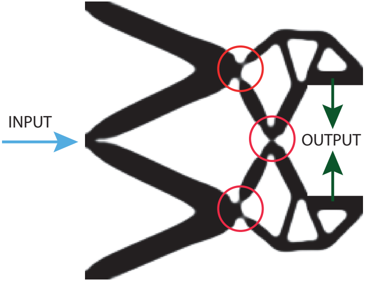
COMPLIANT MECHANISMS



$\lambda_2^{\text{Solid}} = 0.81$

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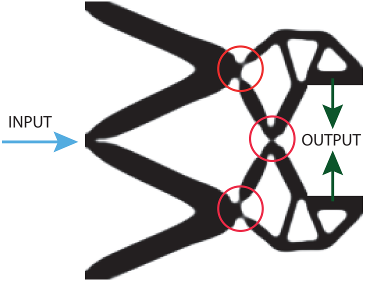

$\lambda_2^{\text{Solid}} = 0.81$

$\lambda_2^{\text{Solid}} = 6.36$