Shape Optimization of a Compact DC Photo-Electron Gun using IGA

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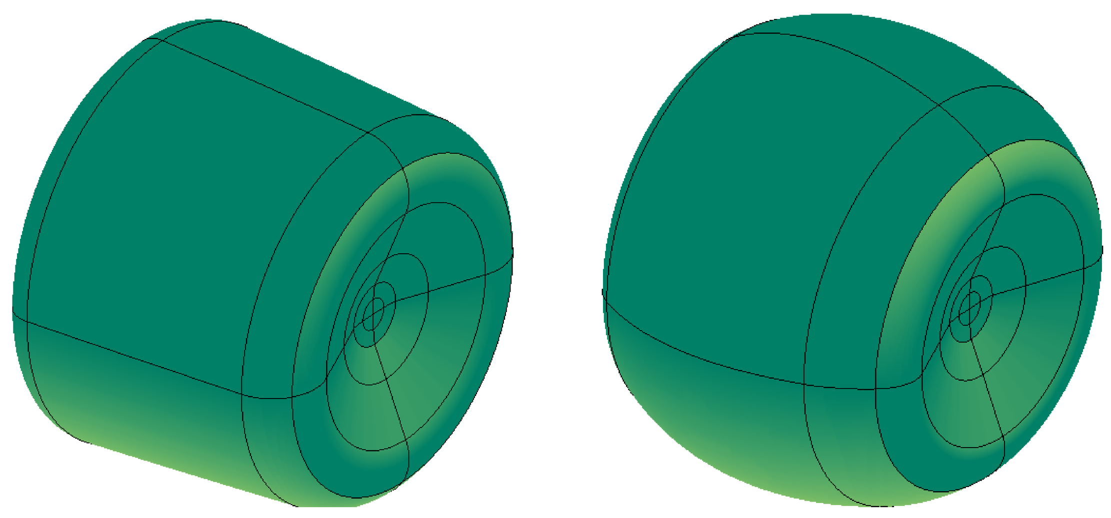
Motivation

Compact DC photo-electron guns meet the demands of high-current applications such as energy recovery linacs. A main design parameter is the electric field strength, which is limited by the field emission threshold of the electrode material. Optimizing the electrode geometry allows for higher gradients and thus increased gun perfomance.



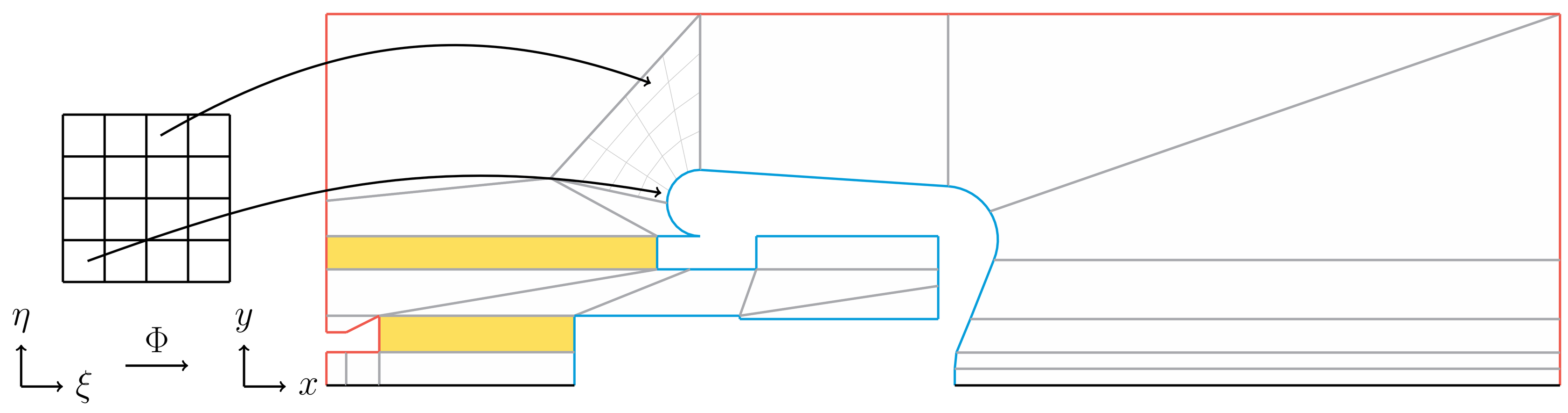
The underlying electrostatic problem is described by Maxwell's equations and the PDE reads

$$\nabla \cdot (\varepsilon \nabla \varphi) = 0 \quad \text{in } \Omega,$$

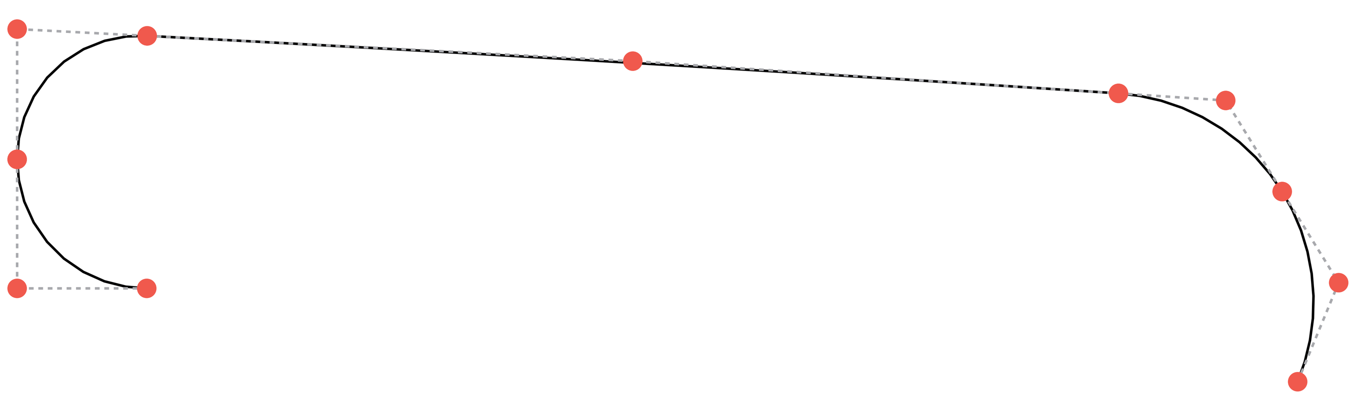
where φ is the electrostatic potential, ε the electric permittivity and Ω the problem domain.

Isogeometric Analysis

Isogeometric Analysis employs NURBS basis functions for both the geometry description and as the solution space of the numerical method. This allows to exactly represent curved geometries and at the same time leads to smooth field solutions.



The elements of a patch share a single parameter space and are mapped to the physical space via a NURBS mapping Φ. Individual curves can easily be manipulated by moving their control points and multiple curves may be glued together to attain higher continuity at their boundaries.



Using the C^1 continuous curve for the optimization guarantees an optimized geometry that is manufacturable.

Geometry Optimization

state optimization problem, show C1 nurbs that is optimized

Results

show field magnitude for starting and optimized geometry (also values?)

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