Enhancing Ornamental Rocks industry Efficiency: Application of Electric Tomography and Poisson coefficient Modulation for Improving marble Characterization

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Talk Abstract

Electric tomography for ornamental rocks modulation [1, 2] specially in marble industry, encounters intricate challenges, notably concerning the determination of conductivity distributions within objects. This work elucidates the nuanced complexities of utilizing the Poisson coefficient within this context, scrutinizing its parameters and components and their implications for marble block modulation. The study holds significant importance in revolutionizing marble characterization and modulation, crucial for various industries such as construction, sculpture, and interior design. By addressing the challenges in determining conductivity distributions within marble blocks, our research aims to pave the way for enhanced efficiency and innovation in the marble sector. The Poisson coefficient [3], a fundamental parameter in materials science and mechanics, plays a crucial role in characterizing the behavior of materials under deformation. In the context of marble block modulation, the Poisson coefficient υ describes the ratio of transverse strain to axial strain when a material is subjected to uniaxial stress. The relationship between this coefficient and the conductivity distribution $\sigma(x, y, z)$ within marble blocks can be mathematically expressed as:

$$\nabla \cdot (\sigma \nabla \vartheta) = 0$$

where

- $\nabla \cdot (\sigma \nabla \vartheta) = 0$, represents the Laplacian operator applied to the conductivity σ and the electric potencial ϑ;

– $\sigma(x, y, z)$ denotes the conductivity distribution within the marble block, which is influenced by factors such as mineral composition and structural imperfections;

– υ is the Poisson coefficient, which describes the material's response to deformation and its influence on the conductivity distribution;

– $\nabla\vartheta$ represents the gradient of the electric potential, describing the spatial variation of electric potential within the object.

However, its application to marble blocks is fraught with obstacles due to the material's unique properties and irregular geometry. Marble blocks exhibit heterogeneous conductivity distributions influenced by factors like mineral composition and structural imperfections. Consequently, applying the Poisson coefficient without accounting for these variations can yield inaccurate conductivity reconstructions. Furthermore, the irregular geometry of marble blocks poses challenges. The Poisson coefficient relies on assumptions about boundary conditions and geometric properties, which may not hold true for the complex shapes of marble blocks. Sharp edges and corners introduce discontinuities in conductivity gradients, complicating modeling and potentially leading to erroneous reconstructions. Additionally, imperfections within marble blocks disrupt the continuity of conductivity distributions. Cracks or impurities confound the interpretation of tomographic data, hindering reconstruction accuracy [4]. To adapt the Poisson coefficient to the problem of marble block modulation and characterization, several modifications and considerations need to be made:

– Adjust boundary conditions to account for the complex geometry of marble blocks;

– Modify the Poisson coefficient model to incorporate imperfections such as cracks or impurities within the marble blocks;

– Validate the modified approach experimentally using data obtained from marble block modulation experiments.

By developing improved methods for electric tomography and conductivity modeling in marble blocks, our study aims to innovate and to maintain its competitiveness and foster innovation in the marble sector in Portugal and beyond. Enhanced characterization techniques will enable more efficient extraction, processing, and utilization of marble resources, contributing to sustainable development and economic growth in the sector [5].

Keywords: Electric tomography, Poisson coefficient, marble blocks, conductivity distributions.

Acknowledgements

This research was supported by national funds through the Fundação para a Ciência e Tecnologia, FCT, under the ICT project UIDB/04683/2020 (https://doi.org/10.54499/UIDB/04683/2020). Also, this work was partially supported by the Fundação para a Ciência e a Tecnologia (Portuguese Foundation for Science and Technology) through the ICT project UID-GEO-04683-2013 with the reference POCI-01-0145-FEDER-007690.

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