'FAQ' Modeling of Tensor Fields, Part II: A Case Study of a Plane Stress Problem*

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In the first part of this paper, we saw why the strategy of problem reformulation is not desirable. We further noted that plane elasticity problems can be solved using the already developed techniques of FAQ. What this means is that the well known Monte Carlo method could have been applied for computing the plane stress or plane strain problems, but, practically speaking, never has been!

In this part of the paper, we computationally model the first fundamental problem of elasticity under the plane stress conditions. A rectangular finite plate with a central circular stress-free hole is loaded under the uniform and uniaxial remote tractions. This is an oft-studied problem, but the novel aspect here is that we solve it without making recourse to Airy's stress function. Of course, in the computational part, we find it convenient to introduce scalar potentials instead of directly computing for the vanishing vector divergence. But this step does not really decouple the governing equations and so it cannot be taken as a weak reformulation. Effectively, the plane stress problem reduces to a set of Laplace's equations. The three stress terms can then be easily reconciled at each evaluation point.

This case study is important from the following angles. (i) By shunning the use of stress functions, this study compels one to think about the stress tensor itself as a physical quantity in its own right. (ii) The software implementation used here is different from certain other techniques such as cellular automata (CA), discrete Huygens method i.e. transmission line matrix method (TLM), lattice random walks (LRW), etc. For example, we do not discretize the surface of the Huygens wavelet. This fact alone substantially reduces aliasing along the grid in a way that is not possible with CA, LRW or even FDM. (iii) Most engineers would mentally associate the words "probability" or "stochastics" with risk, uncertainty, incompleteness of information, etc. They would not associate these words with a fast method of computational mechanics that can *accurately* model the *deterministic* kind of stress fields. This paper provides a concrete example of the second possibility.

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