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On Invariants of the Elasticity Tensor for Orthotropic Materials

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The vast number of composites and textured metals exhibit orthotropic symmetry. Also for biological tissues as well as in damage analysis orthotropic approximation of elastic properties is considered to be admissible. The form of stiffness tensor for linear elastic orthotropic material described by Hooke's law and its spectral analysis is widely known. As it was shown, such tensor is specified by nine independent parameters: six Kelvin moduli and three stiffness distributors specifying three coaxial eigen-states. However, definitions of three stiffness distributors with use of invariants of eigen-states was not yet proposed. Such definitions that allow to specify uniquely elasticity tensor for any orthotropic material is proposed. In order to derive the presented results spectral theorem for elasticity tensor as well as harmonic decomposition for orthogonal projectors of the orthotropic stiffness tensor are used. The proposed approach can be also applied for the stiffness tensors of lower symmetry.

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