Branch Cuts for Multi-valued Functions of Anisotropic Elasticity

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In anisotropic elasticity, the complex variable formalism is a powerful tool for two-dimensional analysis, plate bending analysis, and coupled stretching-bending analysis. Since the complex variable formalisms such as Lekhnitskii formalism [1,2] and Stroh formalism [3,4] are well documented, several analytical solutions for the problems of anisotropic elasticity have been presented in the literature by using complex variable expressions. In computer coding, it is not difficult to write a mathematical equation with real or complex variables. Some functions such as logarithmic function, inverse trigonometric function, power function, mapping function, Plemelj function, etc., are multi-valued in complex variable. In this condition, most of the computer software such as matlab will provide a single function value to users by choosing a proper single-valued region, which is usually called principal value. If this region is not fit to the problem that the users analyze, the solutions calculated through the computer software may be incorrect. Therefore, to get the correct value for a multi-valued function, special care should be made on the selection of branch cut. Although some cautions on the multi-valued function were claimed in the analytical solutions, in the literature it is really difficult to find the related discussions of their numerical evaluation. To correctly code the computer program for the problems with complex variable formulation, some remarks are provided in this paper. The correctness of these remarks is then verified through typical examples on the problems of anisotropic elasticity such as holes, cracks, and punches. The results show that without further modification of the branch cut the solutions generated by the matlab code with multi-valued functions may be incorrect, and the revision of the branch cut is necessary for getting the correct solutions.