Fundamental solutions for two-dimensional anisotropic thermo-magneto-electro-elasticity

Chyanbin Hwu
Department of Aeronautics and Astronautics, National Cheng Kung University, Taiwan, R.O.C.

Chung-Lei Hsu
Department of Aeronautics and Astronautics, National Cheng Kung University, Taiwan, R.O.C.

Chia-Wei Hsu
Department of Aeronautics and Astronautics, National Cheng Kung University, Taiwan, R.O.C.

YC Shiah
Department of Aeronautics and Astronautics, National Cheng Kung University, Taiwan, R.O.C.

Received 20 February 2019; accepted 25 April 2019

Abstract
In this paper, with the consideration of thermal effects, eight equally important systems of constitutive laws generally used to describe anisotropic magneto-electro-elastic (MEE) materials are all considered. We provide simple mathematical relations to convert any one of the eight equation sets to the other seven sets. The equivalent reduced properties for two-dimensional analysis are obtained for eight possible different plane states of MEE solids. Complex variable Stroh formalism is used to derive the fundamental solution for two-dimensional thermo-MEE analysis. By using the identities of Stroh formalism, the complex form solution can be converted into real form. With the real form fundamental solution, the trouble induced by the multi-valued complex logarithmic function is circumvented and the extra line integral that appears in the thermal analysis of the boundary element method (BEM) can be eliminated. Thus, the temperature information inside the domain required by the extra line integral can be avoided, and a truly BEM for thermo-MEE analysis is achieved for the first time in the literature. The influence of heat source represented by the heat generation rate is also considered in our formulation. Verification of our solution is made by comparison with the analytical solution and the solution obtained by BEM using complex form solution with extra line integral as well as the solution by commercial finite element software ANSYS.

Keywords
Anisotropic thermoelasticity, magneto-electro-elastic materials, Stroh formalism, boundary element method

Corresponding author:
Chyanbin Hwu, Department of Aeronautics and Astronautics, National Cheng Kung University, No.1 University Road, Tainan, 70101, Taiwan, R.O.C.
Email: CHwu@mail.ncku.edu.tw