DEPARTMENT OF MECHANICAL ENGINEERING WILLIAM MAXWELL REED SEMINAR SERIES

"DYNAMICS OF THERMOELASTIC HALF-PLANE BY ACTION OF PERIODIC LOADS AND HEAT FLOWS AT ITS BOUNDARY."

Bakhyt Alipova-Turner, Ph.D.
International IT University, Kazakhstan
Samara National Aerospace University, Russia

Presentation Abstract

The problem of dynamics of a thermoelastic half-space under periodic on time surface forces and heat flows is solved using the model of coupled thermoelasticity. The statement of boundary value problem is done with zero initial and definite boundary conditions. The solution of present problem could be found in harmonic form. The Green's tensor for one boundary value problem (BVP) is constructed utilizing Fourier transformation. The analytical solution for arbitrary surface forces and heat flow using the theory of generalized functions are constructed. Taking inverse Fourier transform of the Green's tensor, we obtain the its original in the integral form. To solve the BVP, generalized functions theory, convolution of generalized functions, tensor and differential algebra, operator method and integral transformations were used.

The received solutions (displacements and temperature in the media) allow us to model the dynamics of a thermoelastic half space for different surface forces and heat flow on the boundary. But presented approach allows us to solve different BVPs of coupled thermoelasticity if only 3 out of 6 of boundary functions (displacements components, stresses components, temperature, heat flow) are known. On dependence of BVP, only the form of the matrix of the resolving equations on the boundary must be changed.

The developed approach also provides a method for solving nonstationary BVPs for a thermoelastic half plane. In this case, the solution is Fourier transform in time with nonstationary forces at the boundary and zero initial conditions in the half space. By performing inverse Fourier transform in time of constructed solution, we shall receive the solution of nonstationary problem. It is essential to require the possibility of Fourier transforms of boundary functions.

This method allows to investigate the thermal stress-strain state of a massif under the action of natural / artificial sources of thermoelastic waves, acting on the surface and inside the massif. For internal sources, the Cauchy problem for a thermoelastic space using the Green's tensor of the equations of coupled thermoelasticity is solved first. Then the solution of the problem is determined as the sum of received solution of Cauchy task by using this method.

This approach must find engineering applications in the problems of geophysics and earthquake-resistant construction in the design of surface and underground structures.

Speaker Bio

Prof Bakhyt Alipova-Turner is currently a Lecturer at the International IT University in the Department of Mathematical and Computer Modeling (Kazakhstan) and Samara National Aerospace University in the Department of Space Engineering (Russia). In 2014-2015 she was invited as Fulbright Visiting Scholar at the University of Kentucky in the Mechanical Engineering Department. She worked with Prof. J. McDonough in Optimal SOR parameters for non-Dirichlet elliptic boundary-value problems. She is President of Central Asian Women in Mathematics Association (www.cawma.org) since 2016 (by receiving of IMU CWM grant). For period 1994-2010 she worked in different universities as Scientist/ Adviser/ Teacher: Institute of Mathematics and Mathematical Modelling, Academy of Science of Republic of Kazakhstan, Al-Farabi Kazakh National University etc. Moreover, she worked as Business Analyst and Customer Local Process Driver in the Tetra Pak Central Asian Republics Ltd, Kazakhstan, Sweden. She has 5 Authorized Copyrights and published more than 50 scientific articles. Her research interests are mainly in the field of Computational Numerical Analysis in Thermoelastodynamics: particularly and generalized solutions of transient boundary value problems of coupled/uncoupled thermoelastodynamics in multyconnected areas. For their solving she used and developed generalized functions method, boundary integral equations method and different computational methods, f.e. in Matlab, MathCAD. Also research in the field of Computational Fluid and Flight Dynamics: motion dynamics, including heat transfer, turbulence simulation and modeling; shock capturing; phase change; different media. Also she used some of such approach for mathematical and computer modeling of space flight (f.e. solar sail simulation), simulation of motion of different parts of spaceship etc. She used Mathematical and Computer modeling in the Physical, Chemical, Economic processes: Application of mathematical and computer modeling of different processes – physical (physical phenomena), chemical (flame distribution), economic (Econometrics elements).

Date: Friday, December 10, 2021
Place: Whitehall Classroom Building 114

Time: 3:00 PM EST
Contact: Dr. Alexandre Martin 257-4462

Attendance open to all interested persons

College of Engineering

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UNIVERSITY OF KENTUCKY
LEXINGTON, KENTUCKY