UDC 539.3

Axisymmetric Problem Lemba for the Cosserat Medium

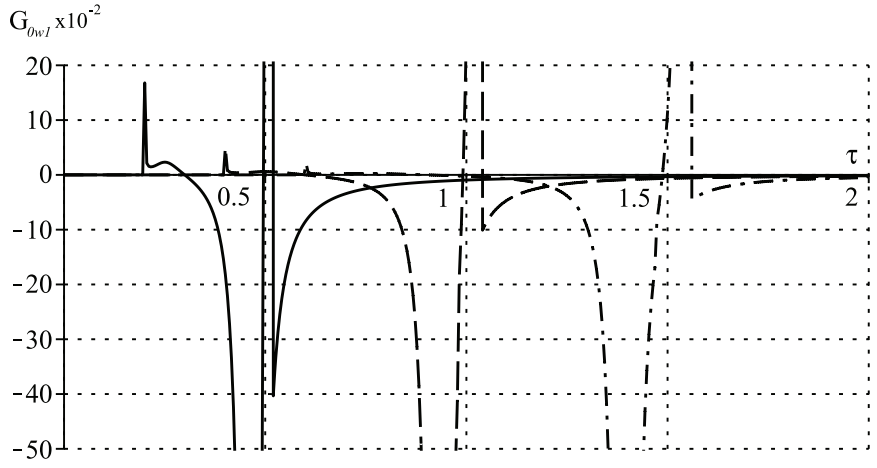
Tran Le Thai, D. V. Tarlakovskii

Tran Le Thai, https://orcid.org/0000-0002-8733-6150, Moscow Aviation Institute (National Research University), 4 Volokolamskoye Shosse, Moscow 125993, Russia, tranlethaivvk@gmail.com
Dmitrii V. Tarlakovskii, https://orcid.org/0000-0002-5694-9253, Institute of Mechanics Lomonosov Moscow University, 1 Michurinsky Ave., Moscow 119192, Russia; Moscow Aviation Institute (National Research University), 4 Volokolamskoye Shosse, Moscow 125993, Russia, tdvhome@mail.ru

The article deals with elastic homogeneous isotropic half-space filled with the Cosserat medium. At the initial instant of time and at infinity, there are no perturbations. At the boundary of the half-space, normal pressures are given. All the components of the stress-strain state are supposed to be limited. A cylindrical coordinate system is used with an axis directed inward into the half-space. With allowance for axial symmetry, the resolving system of equations includes three hyperbolic equations with respect to the scalar potential and the non-zero components of the vector potential and the rotation vector. The components of displacement vectors, rotation angle, stress tensors and stress moments are related to the potentials by known relationships. The solution of the problem is sought in the form of generalized convolutions of a given pressure with the corresponding surface influence functions. To construct the latter, Hankel transformations along the radius and Laplace transformations are applied in time. We use the expansion in power series for a small parameter characterizing the connection between the shear and rotation waves. The images of the first two coefficients of these series are found. The corresponding originals are determined by the connection between the plane and axisymmetric problems. Examples of calculations of the regular components of the influence of a granular composite from an aluminum shot in an epoxy matrix are given.

Key words: Cosserat medium, surface influence functions, Laplace and Hankel integral transformations, the small parameter method, connection between plane and axisymmetric problems.

DOI: 10.18500/1816-9791-2018-18-4-496-506



The function G_{0w1} depends on time τ: the solid curve corresponds $r = 0.2$, dashed — $r = 0.4$, dot-dash — $r = 0.6$

Acknowledgements: This work was supported by the Russian Foundation for Basic Research (project no. 18-08-00471).

References

1. Cosserat E., Cosserat F. *Theorie des corps deformables*. Paris, Librairie Scientifique A. Hermann et Fils, 1909. 226 p. (in French).
2. Erofeev V. I. *Volnovye processy v tverdyh telah s mikrostrukturoj* [Wave Processes in Solids with Microstructure]. Moscow, Moscow Univ. Press, 1999. 328 p. (in Russian).
3. Kulesh M. A., Shardakov I. N. Construction and analysis of some exact analytic solutions of two-dimensional elastic problems within the Cosserat continuum. *Vestn. PGTU. Matematicheskoe modelirovanie sistem i processov* [Bulletin of Perm State Technical University. Mathematical modeling of systems and processes], 2001, no. 9, pp. 187–201 (in Russian).
4. Lai Thanh Tuan, Tarlakovsky D. V. Propagation of non-stationary kinematic perturbations from a spherical cavity in the Cosserat pseudocontinuum. *Mekh. Kompoz. Mater. Konstr.* [Mechanics of composite materials and structures], 2011, vol. 17, no. 2, pp. 184–195 (in Russian).
5. Lai Thanh Tuan, Tarlakovsky D. V. Propagation of nonstationary axisymmetric perturbations from the surface of a sphere filled with a Cousser pseudoelastic medium. *Online journal "Trudy MAI"*, 2012, no. 53. (in Russian). Available at: http://trudymai.ru/published.php?ID=29267/ (accessed 19 April 2012).
6. Lai Thanh Tuan, Tarlakovsky D. V. Diffraction of waves by a spherical cavity in the Cosserat pseudo-continuum. *Radioelectron., Nanosist., Inf. Tekhnol.*, 2013, vol. 5, no. 1, pp. 119–125 (in Russian).
7. Palmov V. A. Basic equations of the theory of asymmetric elasticity. *Applied Mathematics and Mechanics*, 1964. vol. 28, iss. 6. pp. 1117–1120 (in Russian).
8. Belonosov S. M. *Momentnaya teoriya uprugosti: (Statika)*[Moment theory of elasticity: (Statics)]. Vladivostok, Dal'nauka Publ., 1993. 148 p. (in Russian).
9. Bytev V. O., Slezko I. V. Solution of asymmetric elasticity problems. *Mathematical and Informational Modeling* : Collection of scientific papers. Tyumen : Vector Beech, 2008, iss. 10, pp. 27–32 (in Russian).
10. Atoyan A. A., Sarkisyan S. O. Dynamic theory of micropolar elastic thin plates. *Ekol. vestn. nauch. tsentrov CHES*, 2004, no. 1, pp. 18–29 (in Russian).
11. Hirdeshwar S. Saxena, Ranjit S. Dhaliwal. Eigenvalue approach to axially-symmetric coupled micropolar thermoelasticity. *Bull. Pol. Acad. Sci. Techn. Sci.*, 1990, vol. 38, no. 1, pp. 7–18.
12. Suvorov E. M., Tarlakovskii D. V., Fedotenkov G. V. The plane problem of the impact of a rigid body on a half-space modelled by a Cosserat medium. *J. Appl. Math. Mech.*, 2012, vol. 76, no. 5, pp. 511–518. DOI: https://doi.org/10.1016/j.jappmathmech.2012.11.015
13. Tran Le Thai, Tarlakovskii D. V. Nonstationary axisymmetric motion of an elastic momentum semi-space under non-stationary normal surface movements. *Uchenye Zapiski Kazanskogo Universiteta. Seriya Fiziko-Matematicheskie Nauki*, 2017, vol. 159, no. 2, pp. 231–245 (in Russian).
14. Novatsky V. *Teoriya uprugosti* [Theory of Elasticity]. Moscow, Mir, 1975. 872 p. (in Russian).
15. Gorshkov A. G., Medvedskii A. L., Rabinskii L. N., Tarlakovskii D. V. *Volny v sploshnyh sredah* [Waves in Continuous Media]. Moscow, Fizmatlit, 2004. 472 p. (in Russian).
16. Slepian L. I. *Nestacionarnye uprugie volny* [Non-stationary elastic waves]. Leningrad, Sudostroenie Publ., 1972. 351 p. (in Russian).
17. Poruchikov V. B. *Metody dinamicheskoj teorii uprugosti* [Methods of the Dynamic Theory of Elasticity]. Moscow, Nauka, 1986. 328 p. (in Russian).

18. Gorshkov A. G, Tarlakovskii D. V. *Dinamicheskie kontaktnye zadachi s podvizhnymi granicami* [Dynamic contact problems with moving boundaries]. Moscow, Fizmatlit, 1995. 352 p. (in Russian).

Cite this article as:
Tran Le Thai, Tarlakovskii D. V. Axisymmetric Problem Lemba for the Cosserat Medium. *Izv. Saratov Univ. (N. S.), Ser. Math. Mech. Inform.*, 2018, vol. 18, iss. 4, pp. 496–506 (in Russian). DOI: 10.18500/1816-9791-2018-18-4-496-506.