

საერთაშორისო სამეცნიერო ვორქშოპი  
**უწყვეტ გარემოთა მექანიკის  
მონათესავე პრობლემები**

International Scientific Workshop  
**Related Problems  
of Continuum Mechanics**



პროგრამა  
**PROGRAMME**

**BOOK OF ABSTRACTS**  
თეზისების კრებული

**31.10.2019 – 1.11.2019**

**KUTAISI**

# Some Biharmonic Problems and their Application in Technology and Medicine

Hovik Matevossian<sup>1</sup>, Giorgio Nardo<sup>2</sup>, Tokuei Sako<sup>3</sup>

<sup>1</sup>Federal Research Center "Computer Science & Control", & Steklov Mathematical Institute, RAS, Moscow, Russia.

<sup>2</sup>Universita di Messina, Messina, Italy.

<sup>3</sup>Nihon University, Tokyo-Chiba, Japan.

In the present paper we study some properties of solutions of biharmonic problems. Namely, we study the Steklov and Steklov-type boundary value problems for the biharmonic equation. For solving these biharmonic problems with application in technology and medicine, we need to solve the Dirichlet, Neumann and Robin boundary value problems for the Poisson equation using the scattering model.

In order to select suitable solutions, we solve the Poisson equation with the corresponding boundary conditions Dirichlet, Neumann or Robin, that is, some criterion function is minimized in the Sobolev norms. Under appropriate smoothness assumptions, these problems may be reformulated as boundary value problems for the biharmonic equation.

**Keywords:** Biharmonic operator, Steklov and Steklov-type boundary value problems, scattering model, variational methods.

**MSC 2010:** 35J15; 35J35; 35J40; 58J50; 58J90.

## References:

- [1] Brock F 2001, "An isoperimetric inequality for eigenvalues of the Stekloff problem", *Z. Angew. Math. Mech. (ZAMM)*, **81**(1), 69--71.
- [2] Duffin R J 1969, "The influence of Poisson's ratio on the vibrational spectrum", *SIAM J. Appl. Math.*, **17**, 179--191.
- [3] Farwig R 1994, "A note on the reflection principle for the biharmonic equation and the Stokes system", *Acta Appl. Math.*, **34**, 41--51.
- [4] Gazzola F, Grunau H-Ch and Sweers G 2010, *Polyharmonic Boundary Value Problems: Positivity Preserving and Nonlinear Higher Order Elliptic Equations in Bounded Domains*. Lecture Notes Math., **1991**, Springer-Verlag.
- [5] Kondratiev V A and Oleinik O A 1990, "Hardy's and Korn's Inequality and their Application", *Rend. Mat. Appl., Serie VII.* **10**(3), 641--666.
- [6] Kuttler J R and Sigillito V G 1968, "Inequalities for membrane and Stekloff eigenvalues", *J. Math. Anal. Appl.*, **23**(1), 148--160.
- [7] Matevossian H A 2017, "On the biharmonic Steklov problem in weighted spaces", *Rus. J. Math. Phys.*, **24** (1), 134--138.
- [8] Matevossian H 2019, "On the Mixed Dirichlet--Steklov-Type and Steklov-Type Biharmonic Problems in Weighted Spaces", *Math. Comput. Appl.*, **24** (1), 25, 1--9.
- [9] Matevossian H A, Nikabadze M U and Ulukhanian A R 2018, "On solutions of some biharmonic problems and their applications", *IJNSNS Int. J. Nonlin. Sci. Numer. Simul.*, 10 p. (to appear).
- [10] Hovik Matevossian, Tokuei Sako 2019, "Mixed Biharmonic Problems in Exterior Domains", *Abstracts. MMMSEC 2019: I International Conference on "Mathematical Modeling in Materials Science of Electronic Components"* (Moscow, October 21--23, 2019), MAKS Press, Moscow, 2019, p.94, 168 pp.
- [11] Payne L E 1970, "Some isoperimetric inequalities for harmonic functions", *SIAM J. Math. Anal.*, **1** (3), 354--359.
- [12] Antunes Pedro R.S., Gazzola F 2018, Some solutions of minimax problems for the torsional displacements of rectangular plates. *ZAMM Z Angew Math Mech.*, 1--18. DOI: 10.1002/zamm.201800065
- [13] Antunes Pedro R. S., A numerical method for the calculation of extremal Steklov and mixed Steklov eigenvalues, Preprint, 2018