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Mechanics, Energy, Environment

- Proceedings of the 8th International Conference on Energy Planning, Energy Saving, Environmental Education (EPESE '15)
- Proceedings of the 8th International Conference on Geology and Seismology (GES '15)
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Plenary Lecture 1

Fractional Derivatives in Viscoelastic Models and their Organic Relation with Rabotnov's Fractional Exponential Operator

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Abstract: The simplest viscoelastic models involving fractional derivatives, namely: fractional derivative Kelvin-Voigt model, Maxwell model, standard linear solid model and Koeller model, which are the generalization of the fractional derivative standard linear solid model, are reviewed, and their connectedness with the Rabotnov dimensional fractional operators is revealed. Using the resolvent operators for each model, which allow one to express not only the stress in terms of the strain but the strain in terms of the stress as well, it has been shown that not all of the simplest fractional derivative models retain their physical meaning when the fractional parameter vanishes to zero. The role of the resolvent operators is shown for each of the models under consideration, since they allow one to define the physical meaning of the parameters involving in these models. For the Koeller model, it is demonstrated its connectedness with the generalized Rabotnov model involving the sum of Rabotnov fractional operators under the certain restrictions for the coefficients entering into the Koeller model. For the generalized Rabotnov models, formulas coupling the relaxation and retardation times with the elastic moduli entering in these models have been deduced. In conclusion it is emphasized that nowadays the ideas of the Russian Academician Rabotnov are still widely used worldwide for solving intricate static and dynamic problems dealing with behavior of hereditarily elastic bodies.

Brief Biography of the Speaker: Marina V. Shitikova is a Soros Professor of the Department of Structural Mechanics and a leading Researcher of the Research Center of Dynamics of Solids and Structures at Voronezh State University of Architecture and Civil Engineering in Russia. She received her MEng in Civil Engineering in 1982, a PhD degree in Structural Mechanics in 1987 from Voronezh Civil Engineering Institute, a DSc degree in Solid Mechanics in 1995 from the Institute for Problems in Mechanics, Russian Academy of Sciences and a Professorship in 1995 from Voronezh State University of Architecture and Civil Engineering. Since 1994, she has been an Associate Member of the Acoustical Society of America, since 1995 she has been a Member of the EUROMECH, GAMM, the ASME International, and Russian Association "Women in Science and Education". She has published more than 200 papers dealing with structural mechanics, vibrations, wave dynamics, and acoustics. Her biography has been included in Who's Who in the World, Who's Who in Science and Technology, 2000 Outstanding Scientists of the 20th Century. She received a Commemorative Medal "1997 Woman of the Year" from the American Biographical Institute. In 1998 she was awarded the Russian President Fellowship for Outstanding Young Doctors of Sciences. Since 2009 she is the Head of the Department of International Education and Cooperation at Voronezh State University of Architecture and Civil Engineering. She was a Fulbright Fellow at Rice University, Houston, Texas in 2007-2008 and a Visiting Professor in different universities.