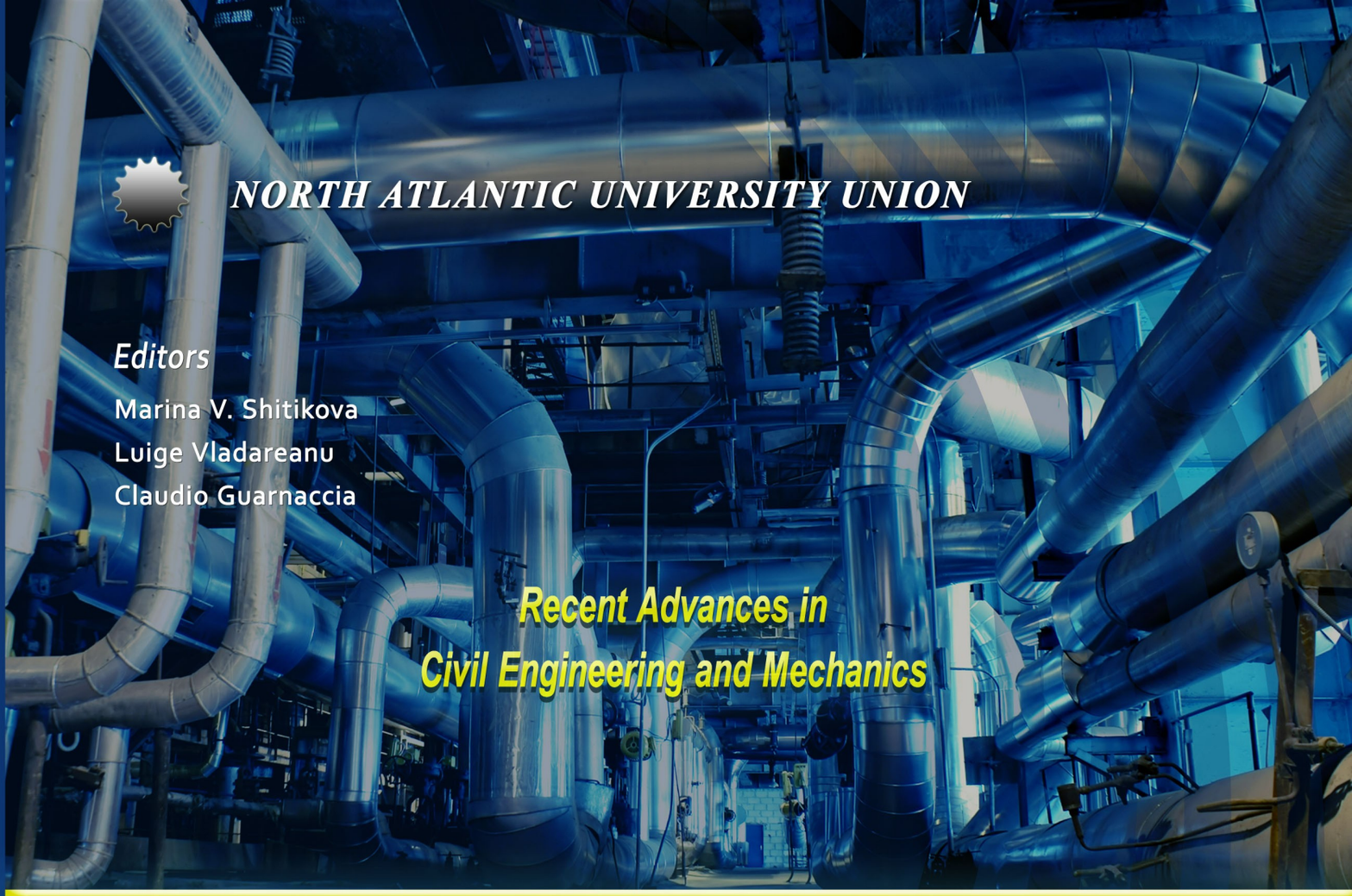

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Plenary Lecture 1

Dynamics of Suspension Bridges: Nonlinear Free and Forced Vibrations with Internal Resonances

Professor Marina V. Shitikova
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Research Center on Dynamics of Solids and Structures
Voronezh State University of Architecture and Civil Engineering
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Abstract: This survey paper is devoted to the analysis of dynamic behavior of suspension bridges subjected to the different conditions of the internal resonances.
First we consider nonlinear free damped vibrations of a suspension bridge with a bisymmetric stiffening girder under the conditions of the internal resonance one-to-one, i.e., when natural frequencies of two dominating modes - a certain mode of vertical vibrations and a certain mode of torsional vibrations - are approximately equal to each other, or two-to-one, when one frequency is twice larger than the other. Damping features of the system are defined by fractional derivatives with fractional parameters (the orders of the fractional derivatives) changing from zero to one. It is assumed that the amplitudes of vibrations are small but finite values, and the method of multiple scales is used as a method of solution. The influence of uncertainty in choosing the fractional parameters on the character of nonlinear damped vibrations of suspension bridges is investigated.
Then nonlinear forced vibrations of suspension bridges, when the frequency of an external force is approaching one of the natural frequencies of the suspension system, which, in its turn, undergoes the conditions of the one-to-one internal resonance, are investigated via the method of multiple time scales. The damping features are described by the fractional derivative, which is interpreted as the fractional power of the differentiation operator. The influence of the fractional parameters (orders of fractional derivatives) on the motion of the suspension bridge model is investigated.

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.

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