International Round Table

Mathematical and Computational Modelling in Cardiovascular Problems: Forms of International Collaboration

Working group on mathematical models and numerical methods in biomathematics

Yuri Vassilevski

Institute of Numerical Mathematics RAS

Round Table "Mathematical and Computational Modelling in Cardiovascular Problems: Forms of International Collaboration"

Brief history of INM RAS

The founder of INM academician Gury Marchuk

- 1980: Dept. of Numerical Mathematics of USSR AS
- 1991: Institute of Numerical Mathematics RAS
- 1997: address of INM becomes Gubkina str.8
- 1980-2000: director Gury Marchuk
- 2000-2010: director Valentin Dymnikov
- 2010-present: director Eugene Tyrtyshnikov

Scientific directions

- numerical mathematics, informatics, parallel computations
- mathematical modelling in science and technology

Scientific directions

numerical mathematics, informatics, parallel computations

- numerical methods
  - discretization methods
  - matrix and tensor computations
  - methods of theory of control
- parallel computing and HPC
- computational technologies
  - all stages (domain-mesh-discretization-solution)
- methods of data transformation, analysis and structuring

Scientific directions

mathematical modelling in science and technology

- atmosphere hydrothermodynamics (meteorology)
- dynamics of ocean and seas and data assimilation
- regional climate processes
- global climate and its changes
- dynamics of aerosols (ecology, fires, smog)
- technical hazards and natural catastrophes (dam breaks, landslides, pollution)
- processes in human organism (immune, infectious, blood circulation), epidemiology

Other facts about INM

- 27 Habil., 24 PhD, 10 graduate students
- courses in MIPT and MSU, 8 PhD defences in 2013
- 6 laboratories in other research centers
- 75% of the budget is formed by grants, contracts etc.
- Contracts with ExxonMobil, Rosneft, Rosatom, Nissan etc.

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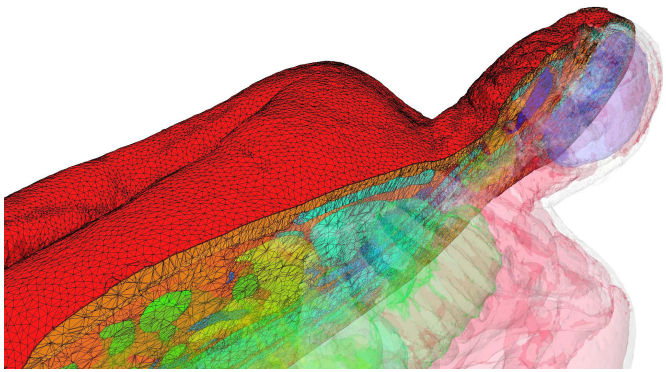
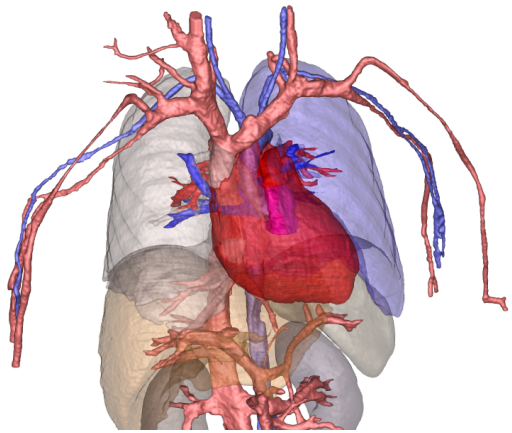
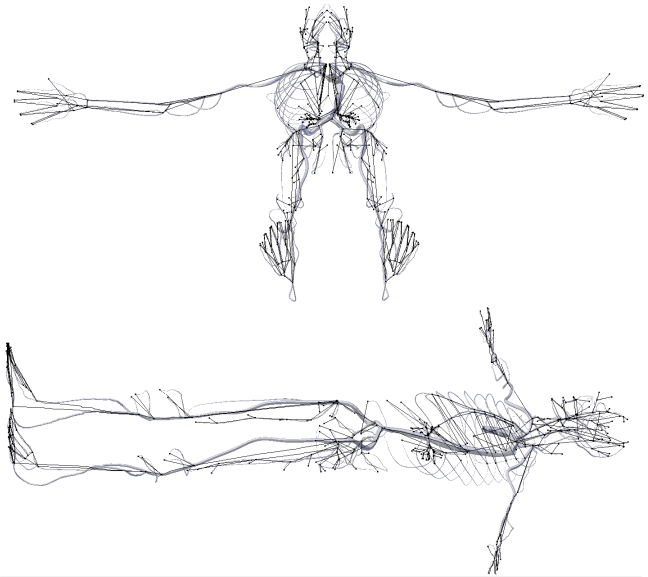
Informatics technologies in bioimpedance diagnostics and computational haemodynamics

- 3D reconstruction of human body with resolution of organs, tissues, systems
- Mesh generation for human body and its parts (e.g. vascular system)
- Development of mathematical models:
  - Optimization of bioimpedance diagnostics (lung hydration, body composition)
  - Virtual blood circulation (surgery, pathologies)







Presentations from INM and affiliates at the workshop

- Alexander Danilov (INM) High resolution human body computational models
- Yuri Ivanov (INM) Patient specific reconstruction of vascular network for haemodynamic modelling
- Sergey Simakov (MIPT) Computational haemodynamics for clinical practice
- Victoria Salamatova (MIPT) Modelling of soft tissue deformation
- Tatyana Dobroserdova (INM) Numerical simulation of blood flow in the vascular network with pathologies or implants
- Timur Gamilov (INM) Modelling of passive blood flow stimulation
- Vasily Kramarenko (MIPT) Natural user interfaces for mathematical models dealing with real human anatomy

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Working group on mathematical models and numerical methods in biomathematics

- Informal society of modelers and mathematicians since 2010
- Activities
  - Series of workshops
  - Special issues in international journals
  - Website *dodo.inm.ras.ru/biomath*

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Series of workshops at INM RAS

1. 15-16 June 2010: 16 talks, 2 (F)
2. 11-12 January 2011: 18 talks, 2 (regions), 1 (F), 1 (UK)
3. 27-28 October 2011: 21 talks, 4 (regions), 2 (F)
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- In total about 100 talks, more than 100 participants/members
- 9 groups for cardiovascular modeling in Russia (MSU 2, MIPT 2, Cnt.Hem. 2, INM-MIPT, Ebrg, Nsk, SPb) presented 25 talks
- 7 talks on cardiovascular modelling from western countries

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It will be combined with the International Workshop "Multiscale Modelling and Methods in Biology" (sponsored by French agencies, $\sim$ 15 participants)

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Workshops become more international. You are welcome!

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Special issues of journals

Peer-reviewed papers in

1. Math.Modelling of Natural Phenomena 6, No.7, 2011 (EDP Science)
   7 papers (2 ♡)
2. Rus. J. Numer.Analysis and Math.Modelling 26, No.6, 2011 (De Gruyter)
   7 papers (4 ♡)
3. Rus. J. Numer.Analysis and Math.Modelling 27, No.5, 2012 (De Gruyter)
   7 papers (3 ♡)
4. Rus. J. Numer.Analysis and Math.Modelling 28, No.5, 2013 (De Gruyter)
   5 papers (3 ♡)
5. Rus. J. Numer.Analysis and Math.Modelling 29, No.5, 2014 (De Gruyter)

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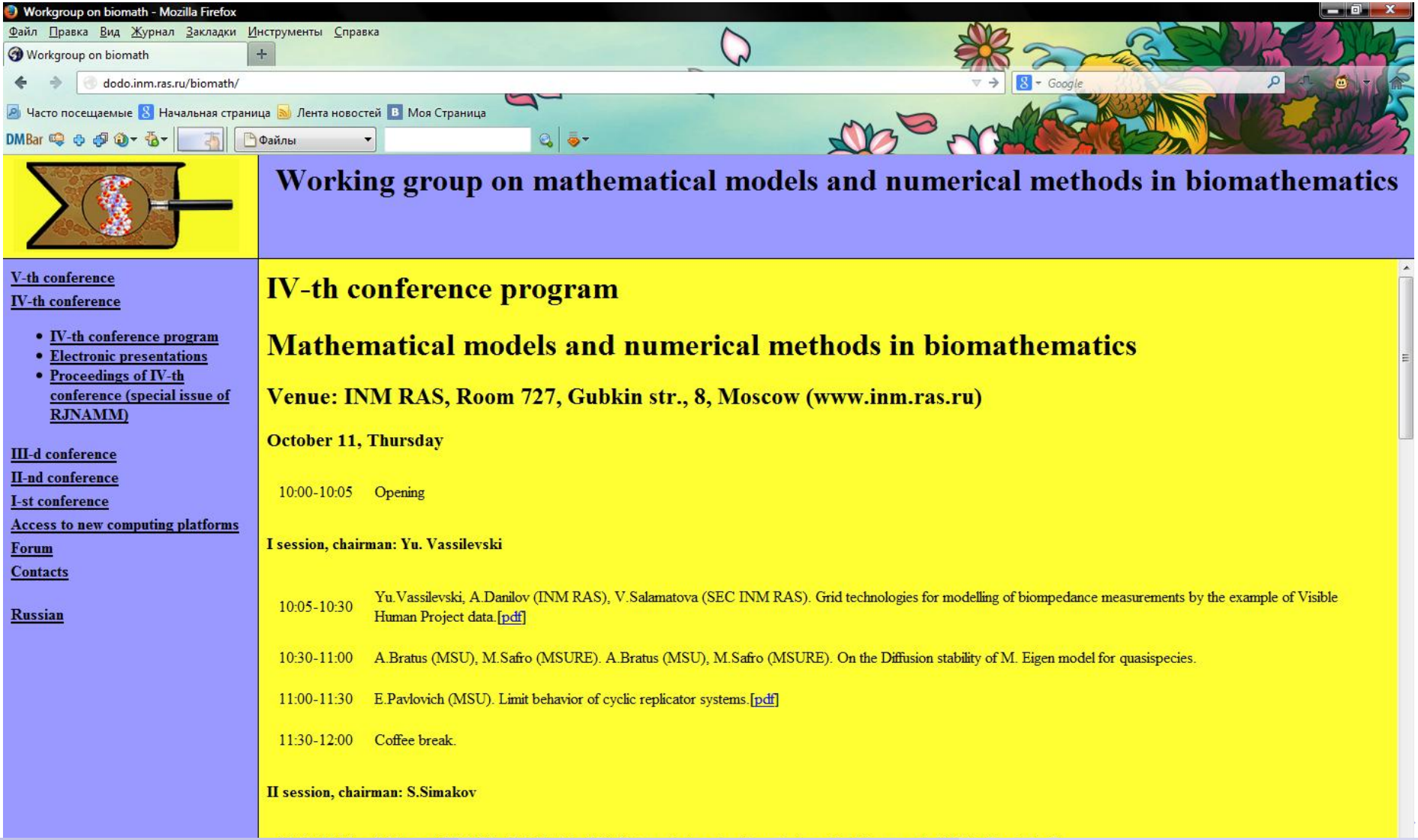

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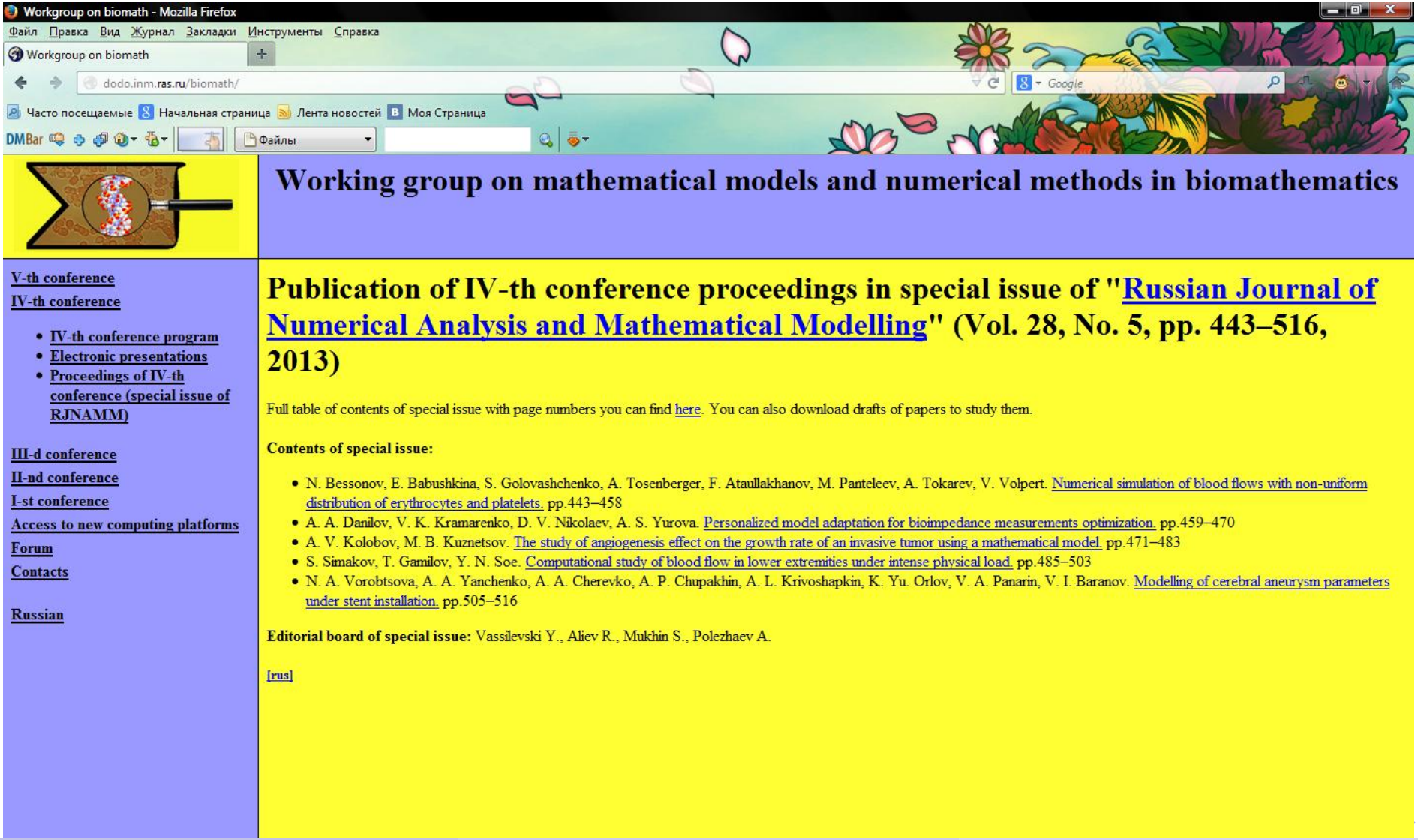

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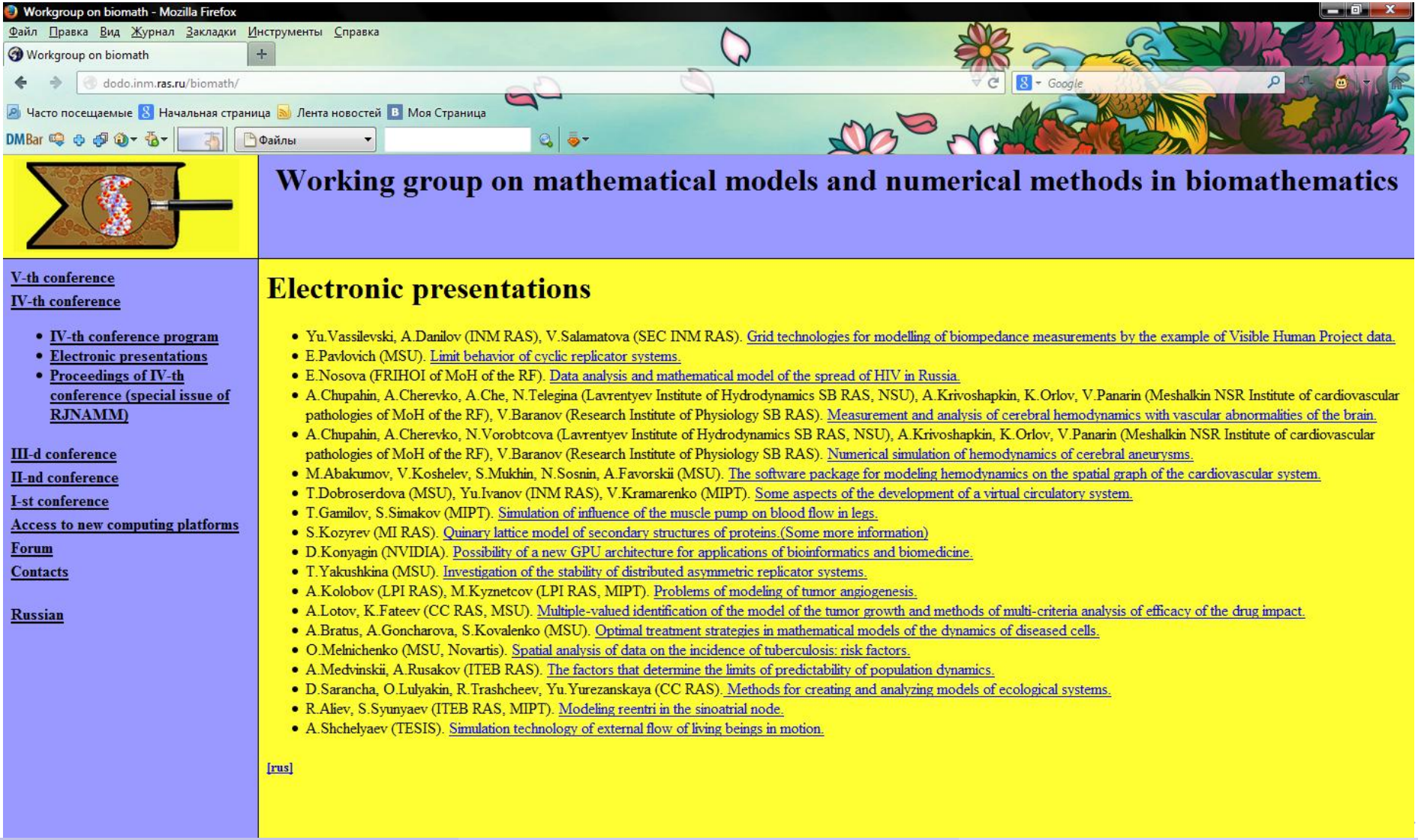

THANK YOU FOR YOUR ATTENTION!