

## CURRICULUM VITAE

<b>SURNAME AND NAME</b>	<b>Ruotsalainen Keijo</b>
<b>Home Address</b>	
<b>Phone number</b>	
<b>Fax number</b>	
<b>E-mail address</b>	
<b>Nationality</b>	<b>Finland</b>
<b>Birth date</b>	

### Academic Position (if the candidate holds a position in a University)

Qualification/Title	<b>Professor</b>
University	<b>University of Oulu</b>
Department	<b>Applied and Computational Mathematics</b>
Academic Field	<b>Applied and Computational Mathematics</b>
Academic Discipline	<b>Spectral analysis of waveguides</b>

### Working experience (please use the following table in order to briefly describe the working positions covered by the candidate)

Dates ( from .. to..)	<ol style="list-style-type: none"> <li>1. from 1.8.1984 to 31.7.1986</li> <li>2. from 1.8.1986 to 31.7.1988</li> <li>3. from 1.8.1988 to 31.7.1998</li> <li>4. from 1.8.1998 to 31.7.2002</li> <li>5. from 1.8.2002 to 31.8.2004</li> <li>6. from 1.9.2004 to present</li> </ol>
Name and address of the Employer (Public or/and private institution/body)	<p><b>1.-3. and 5.-6.:</b> University of Oulu, Pentti Kaiterankatu 1, 90014, Oulu, Finland</p> <p>4. Nokia Mobile Phones, Research and Technology Access Unit, Elekroniikkatie 3, 90014, Oulu</p>
Position held (for positions in Universities, the candidate should indicate the Faculty/College/School and the Department)	<ol style="list-style-type: none"> <li>1. <i>Assistant, Faculty of Technology, Mathematics Division</i></li> <li>2. <i>Senior assistant, Faculty of Technology, Mathematics Division</i></li> <li>3. <i>Senior lecturer, Faculty of Mathematics, Mathematics Division</i></li> <li>4. <i>Senior Scientist, base band signal processing</i></li> </ol>

	<p><b>5. Senior lecturer, Faculty of Technology, Mathematics Division</b></p> <p><b>6. Professor (full), Faculty of Technology (since 1.1.2014 Faculty of Information Technology and Electrical Engineering), Department of Applied and Computational Mathematics</b></p>
Main activities/responsibilities	<p><b>Head of Department since 1.1.2005.</b></p> <p><b>Chairman of the students enrolment committee since 1.1.2005</b></p> <p><b>Chairman of the Examination Board since 1.1.2014</b></p> <p><b>Member of Faculty Council since 1.1.2003</b></p>

**Education and Training (please use the following table to describe Degrees awarded, by only indicating the information concerning Bachelor's Degree, Master of Science's Degree or/and PhD)**

Date	<p><b>1. 28.2.1984</b></p> <p><b>2. 19.8.1987</b></p>
Institution which issued the degree	<b>1. and 2.:</b> University of Jyväskylä
Type of Degree awarded (only Bachelor's Degree, Master of Science's Degree, PhD)	<p><b>1. Master of Science, mathematics</b></p> <p><b>2. Doctor of Philosophy (=PhD)</b></p>

#### **INTERNATIONAL REFEREES INDICATED BY THE CANDIDATE**

Each candidate is required to indicate the names of at least three and not more than five international experts/referees: they must not have any publications in common with the candidate and must possess a high scientific qualification and international reputation, that can be objectively verified by the Commission.

<b>Name</b>	<b>Institution of origin</b>	<b>Address</b>	<b>e-mail address (compulsory)</b>
<b>Ann-Sophie Bonnet-BenDhia</b>	ENSTA, ParisTech, UMA	ENSTA/POEMS, 828 Boulevard des Maréchaux, 91120, Palaiseau, France	Anne-Sophie.Bonnet-BenDhia@ensta-paristech.fr
<b>Günter Leugering</b>	Friedrich-Alexander Universität Erlangen-Nürnberg, Department of Mathematics	Cauerstrasse 1, 91058, Erlangen	guenter.leugering@fau.de
<b>Martin Costabel</b>	Université de Rennes	IRMAR, Institut Mathématique, Campus Beaulieu, 35042, Rennes, France	costabel@univ-rennes1.fr
<b>Andrei Piatnitski</b>	Arctic University of Norway and Russian Academy of Science	The Institute for Information Transmission Problems, Russian Academy of Sciences Bolshoi Karetny per. 19, Moscow 127051, Russia	andrei@sci.lebedev.ru

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## EVALUATION FIELDS

### 1. Scientific Activity

**1.1** The three most important outcomes/results of the research activity of the candidate accompanied by the tangible and verifiable evidence that the presented results:

- are original, significant and due to the determining, prevailing and clearly recognizable contribution of the candidate;
- have been widely spread and have obtained outstanding recognitions by the international scientific community;
- qualify the candidate as a distinguished international expert in his/her own field.

1. K. Ruotsalainen and W.L. Wendland, On the boundary element methods for some nonlinear boundary value problems, *Numer. Math.* , 1988, vol. 53, p. 299–314

2. T. Torsti, T. Eirola, J. Enkovaara, T. Hakala, P. Havu, V. Havu, T. Höynälänmaa, J. Ignatius, M. Lyly, I. Makkonen, T. Rantala, J. Ruokolainen, K. Ruotsalainen, E. Räsänen, H. Saarikoski and M. Puska; Three real-space discretization techniques in electronic structure calculations, *Physica Status Solidi (b)*, vol. 243, No. 5, (2006), p. 1016-1053

3. G. Cardone, S.A. Nazarov, K. Ruotsalainen; Bound states of a converging quantum waveguide, *ESAIM: Mathematical modelling and Numerical Analysis*, vol. 47, Issue 1 (2013), p. 305-315.  
(\textbf{DOI}: 10.1051/m2an/2012033)

**1.2** List of the submitted publications (with a maximum number of 20) in addition to those listed at point 1.1. For each publication and/or set of publications, the candidate is required to briefly describe his/her contribution, their scientific/technical significance and individual importance, the overall impact of the results in the international scientific community.

1. K. Ruotsalainen and J. Saranen, Some boundary element methods using Dirac's distributions as trial functions, *SIAM J. Numer. Anal.*, vol. 24, p. 816 – 827, 1987.
2. K. Ruotsalainen and J. Saranen, A Dual Method to the Collocation Method, *Math. Meth. in Appl. Sci.*, vol.10 , 1988, p. 439 – 445
3. K. Ruotsalainen and J. Saranen, On the convergence of the Galerkin method for some nonsmooth solutions of integral equations, *Numer. Math.*, vol. 54, 1988, p. 295--302
4. K. Ruotsalainen and J. Saranen, On the collocation method for a nonlinear boundary integral equation, *J. Comp. and Appl. Math.*, vol. 28 ,1989
5. K. Ruotsalainen, Remarks on the boundary element method for strongly nonlinear problems, *Journal of Austr. Math. Soc., series B*, vol. 34, p. 419--438, 1992
6. K. Ruotsalainen, On the convergence of the collocation method for nonlinear boundary integral equations, *J. of Comp. and Appl. Math.*, vol. 50, p. 471--483, 1994
7. J. Kempainen and K. Ruotsalainen; Boundary Integral solution of the time-fractional diffusion equation, *Integr. Eq. Oper. Theory*, vol. 64, pp. 239-249 (2009)
8. J. Kempainen and K. Ruotsalainen; On the spline collocation method for the single layer equation related to time-fractional diffusion, *Numer. Algor.*, Vol. 56 (2011), DOI:<http://dx-doi.org/10.1007/s11075-010-9430-9>
9. T. Höynälänmaa, K. Ruotsalainen and T. Rantala; Solution of atomic orbitals in interpolating wavelet basis, *Phys. Rev. E* 70, No. 6, 066701 (2004)
10. T. Torsti, T. Eirola, J. Enkovaara, T. Hakala, P. Havu, V. Havu, T. Höynälänmaa, J. Ignatius, M. Lyly, I. Makkonen, T. Rantala, J. Ruokolainen, K. Ruotsalainen, E. Räsänen, H.

- Saarikoski and M. Puska; Three real-space discretization techniques in electronic structure calculations, *Physica Status Solidi (b)*, vol. 243, No. 5, (2006), p. 1016-1053
11. S.A. Nazarov, K. Ruotsalainen and J. Taskinen; Essential spectrum of a periodic elastic waveguide may contain arbitrarily many gaps, *Appl. Anal.*, vol. 90, No.1 (2010), pp.109–124
  12. F.L. Bakharev, S.A. Nazarov, K. Ruotsalainen; A gap in the spectrum of the Neumann-Laplacian on a singularly perturbed periodic waveguide, *Appl. Anal.*, 92, issue 3, 2013 (<http://dx.doi.org/10.1080/00036811.2012.711819>)
  13. V. Chiad\o Piat, S.A. Nazarov, K. Ruotsalainen; Spectral gaps for water waves above a corrugated bottom, *Proc. Royal Soc. London A* (2012), vol. 469, no. 2149 20120545 (doi: 10.1098/rspa.2012.0545)
  14. S.A. Nazarov, K. M. Ruotsalainen and P. Uusitalo; The Y-junction of quantum waveguides, *Z. angew. Math. Mech.*, **94**(6) 477--486 (2014). doi: 10.1002/zamm.201200255
  15. Nazarov S.A., Ruotsalainen K.; Criteria for trapped modes in a cranked channel with fixed and freely floating bodies, *Z. Angew. Math. Phys.*, 65 (2014), 977–1002. DOI 10.1007/s00033-013-0386-1
  16. S.A. Nazarov, K. M. Ruotsalainen and P. Uusitalo; Bound states of waveguides with two right-angled bends, *Journal of Math. Phys.*, 56, 021505 (2015); doi: 10.1063/1.4907559.
  17. Kempainen J., Nazarov S.A. and Ruotsalainen K. M.; Perturbation analysis of embedded eigenvalues for water waves, *J. Math. Anal. Appl.* (2015), DOI:10.1016/j.jmaa.2015.02.050.
  18. S.A. Nazarov, K.M. Ruotsalainen, P. Uusitalo; Asymptotics of the spectrum of the Dirichlet Laplacian on a thin carbon nano-structure, *Comptes Rendue M\{e}canique* (2015), vol. 343, 360--364, (DOI: 10.1016/j.crme.2015.03.001)
  19. S.A. Nazarov and K. M. Ruotsalainen; A rigorous interpretation of approximate computations for embedded eigenfrequencies of water waves, *ZAA* (2016), 35(2), 211–242 (DOI: 10.4171/ZAA/1563)
  20. Nazarov S.A., Ruotsalainen M. and Silvola M.; Trapped modes in piezoelectric and elastic waveguides, *Journal of Elasticity*, Vol. 124, No. 2, pp. 193-223 (2016), DOI 10.1007/s10659-015-9565-y

Articles 1.-8. presents my work on Boundary Element Methods. They are joint papers, where all co-authors have the equal share. Along the joint paper with W.L. Wendland mentioned at point 1.1 the constitute the first results on BEM for computing non-linear problems using collocation and Galerkin methods. The papers 1.-3. constitute a complete stability analysis of BEM on smooth curves. The results have gained later, almost 30 years after their publication, a new life in present BEM-analysis.

Articles 9 and 10 presents the application of wavelets to electronic structure calculations in molecules. Article 10 presents three different computational method. I was responsible for the part for wavelets. It is the most cited paper.

Finally the papers 11-20 is a representation of my present research activity. They contain among all the first rigorous results on the band gap structure of the spectrum for the Steklov spectral problem in periodic water domains. In the joint works on quantum waveguides with Nazarov, Cardone and Uusitalo we shed new light for the existence of bounded states below the continuous spectrum. The findings, especially in paper 18, are of most important for the validity of the Kirchoff transmission condition on quantum graphs. The last work (20) together with the article 15 considers the possibility for the existence of trapped modes embedded in the continuous spectrum. To my knowledge it is the first one.

**1.3** Complete list of all the significant publications of the candidate, including those listed at points 1.1 and 1.2 (to be attached to the end of the Curriculum).

**2. Coordination of research and technology transfer groups and projects.**

- Coordination and management of research groups, possibly with international relationships and collaborations; explicit mention of the number and of the type of PhD and Post-Doc students, of whom the candidate has been the academic supervisor;
- Scientific responsibility (Principal Investigator) of competitive National and International research projects, awarded through a peer-review process.
- Scientific responsibility of National and International research projects, ruled through partnership agreements with companies and/or public private bodies, which are leaders in their own sector.
- Outcomes obtained in the field of technology transfer, in terms of participation in start-ups and spin-offs, development, use and commercialization of patents/licenses.

A) Head of applied and computational mathematics research group.

B) International collaboration: Prof. S.A. Nazarov, Russian Academy of Sciences. Prof. V. Chiadò Piat, Politecnico di Torino. F. Bakharev, Chebyshev laboratory of St. Petersburg State University. Prof. G. Cardone, Università di Sannio. Prof. J. Taskinen, University of Helsinki. Prof. S. Nicaise, University of Valenciennes, Prof. C. Constanda, University of Tulsa.

C) PhD students:

- Jukka Kemppainen 2010

- Pauliina Uusitalo 2016

D) Research projects:

1. Infotech Oulu: Algebraic and Computational Methods in Information Sciences (2006-2010)

2. Finnish Academy of Sciences: Information theoretic and mathematical methods for space-time coded broadband wireless communications (2003-2007)

3. Wihuri Foundation: Asymptotic and Computational Analysis of Waveguides (2015-2016)

E) A patent: Method and apparatus for modulation using an at least four-dimensional signal constellation, US Patent No. 7,230,993: June 12 2007 (owned by Nokia).

**3. National and international reputation and professional activity for the scientific community**

- Official research and/or teaching and/or fellowship roles, positions as Scholar/ Visiting Professor in international highly qualified universities and research centres.:
- Offices in the Governing bodies of national and international scientific societies.
- Participation in Academies with international reputation in the research field of the candidate.
- Prizes and awards awarded to the candidate for his/her scientific activity and project activity in the Academic Fields, where this is appropriate.
- Participation in international conferences, as a distinguished invited speaker; participation in the scientific committees of International Conferences.

A) Visiting professorships and research fellowships:

- 1984 Technische Hochschule Darmstadt, DAAD-fellow

- 1985-1987 Universität Stuttgart, DAAD-fellow

- 1989 University of New South Wales, visiting research fellow
  - 1995 CNRF-ITEF, Padova, visiting researcher
  - 1998 University of Valenciennes, visiting professors
  - 2016 Visiting Politecnico di Torino (funded by INDAM and Wihuri Foundation)
  - 1990- present: several 1-3 week visits to University of Thessaloniki (hosted by Prof. P.D. Panagiotopoulos), Charles University in Prague (hosted by Prof. J. Nečás), Oberwohlfach, Politecnico di Torino (hosted by Prof. V. Chiadò Piat), Instituto Superiore Tecnico (Lissabon) (hosted by Prof. J. Videman)
- B) Offices in governing bodies of scientific societies and conferences:
- International steering committee of the Integral Methods in Science and Engineering
  - Advisory board of SCOMA (Center for Scientific Computation and Optimization in Multidisciplinary Application, Univ. of Jyväskylä)
- C) Participation on conferences as invited speaker:
- The third IMSE conference 1993 in Sendai, Japan
  - The 6<sup>th</sup> Colloquium of the DFG-priority research program “Boundary Element Methods” 29.9.-2.10.1994 Schmalleberg (Germany)
  - 15.-16. September 2016 “Recent trends in the analysis of spectral problems and applications”

***If the candidate has obtained the National Scientific Qualification in more than one Academic Field this must be considered a qualifying element, for properly evaluating the scientific reputation of the candidate.***

#### **4. Teaching activity**

- Formal responsibility of Bachelor’s and Master of Science’s degree courses in Italian and/or foreign universities.
- Formal responsibility of PhD courses in Italian and/or foreign universities.
- Formal responsibility of Specializing Master’s courses and Life Learning courses in Italian and/or foreign universities in PhD courses.

Responsibility of mathematics curricula for engineering students at the University of Oulu.

1. Bachelor level courses:
  - Differential equations
  - Complex analysis
  - Signal analysis
  - Analytic geometry
  - Matrix algebra
  - Numerical methods
2. Master level courses:
  - Optimization methods
  - Computational techniques for PDEs
  - Wavelets and their applications
3. PhD level courses:
  - Spectral analysis of waveguides

Responsibility of PhD level courses in foreign universities

- Asymptotic and computational analysis of waveguides, Spring term 2016, Politecnico di Torino

#### **5. Institutional offices and roles in Italian and foreign Universities and/or public and private institutions with scientific and/or technology transfer aims**

- Institutional offices and roles in the Governing bodies (Academic Senate, Board of Governors) of Italian and/or foreign universities:
  1. 2005-present: Head of the Department of Applied and Computational Mathematics
  2. 2002-2008: Member of the Faculty Council
  3. 2005-present: Chairman of the Student Admission Committee
  4. 2013-present: Chairman of the Board of Examiners at the University of Oulu
- Institutional offices and roles in teaching and research structures (Departments, Faculties, Schools, Colleges) and other service activities developed in Italian and Foreign Universities.
  1. 2008-2012: Board member of the Finnish Doctoral Program on Computational Sciences
  2. 2012-present: Advisory board of SCOMA (Center for Scientific Computation and Optimization in Multidisciplinary Application, Univ. of Jyväskylä)
  3. 2005-2010: Vice-chairman of the Post-graduate Studies Committee at the

Torino 30/11/2016

### **Complete list of publications**

- [1] I. Lusikka, K. Ruotsalainen and J. Saranen, Numerical implementation of the boundary element method with point-source approximation of the potential, *Engineering Analysis*, vol. 3, 1986, p. 144–153
- [2] K. Ruotsalainen and J. Saranen, Some boundary element methods using Dirac's distributions as trial functions, *SIAM J. Numer. Anal.*, vol. 24, p. 816–827, 1987
- [3] K. Ruotsalainen, On the boundary element method with mesh refinement on curves with corners, *J. Comp. and Appl. Math.* vol. 20 , 1987, p. 373–378
- [4] P. Neittaanmäki and K. Ruotsalainen, On the numerical solution of the bifurcation problem for the Sine-Gordon equation, *Arab J. of Maths*, vol. 6 , 1985, p. 37–62
- [5] K. Ruotsalainen and W.L. Wendland, On the boundary element methods for some nonlinear boundary value problems, *Numer. Math.* , 1988, vol. 53, p. 299–314
- [6] K. Ruotsalainen and J. Saranen, A Dual Method to the Collocation Method, *Math. Meth. in Appl. Sci.*, vol.10 , 1988, p. 439–445
- [7] K. Ruotsalainen and J. Saranen, On the convergence of the Galerkin method for some nonsmooth solutions of integral equations, *Numer. Math.*, vol. 54, 1988, p. 295–302
- [8] K. Ruotsalainen and J. Saranen, On the collocation method for a nonlinear boundary integral equation, *J. Comp. and Appl. Math.*, vol. 28 ,1989

- [9] M. Hamina, K. Ruotsalainen and J. Saranen, About numerical solution of a nonlinear boundary integral equation with collocation method, *Z. Angew. Math. Mech.*, vol. 70, p. T703–T 705 , 1990
- [10] K. Ruotsalainen, On the boundary element method for a mixed nonlinear boundary value problem, *Applicable Analysis*, 1992, vol. 46, p. 195–213
- [11] M. Hamina, K. Ruotsalainen and J. Saranen, The numerical approximation of the solution of a nonlinear boundary integral equation with the collocation method, *J. Int. Eqs. And Appl.*, 1992, vol. 4, p. 95–116
- [12] K. Ruotsalainen, Remarks on the boundary element method for strongly nonlinear problems, *Journal of Austr. Math. Soc., series B*, vol. 34, p. 419–438, 1992
- [13] K. Ruotsalainen, On the convergence of the collocation method for nonlinear boundary integral equations, *J. of Comp. and Appl. Math.*, vol. 50, p. 471–483, 1994
- [14] I. Saarinen, A. Mämmelä, P. Järvensivu and K. Ruotsalainen; Power Control in Feedback Communications over a Fading Channel, *IEEE Trans. Vehicular Technology*, vol. 50, Issue 5, 2001
- [15] T. Höynälänmaa, K. Ruotsalainen and T. Rantala; Solution of atomic orbitals in interpolating wavelet basis, *Phys. Rev. E* 70, No. 6, 066701 (2004)
- [16] J. Hämäläinen, S. Savolainen, R. Wichman, K. Ruotsalainen and J. Ylitalo; Integral equation formulation for scatter density problem, *Electr. Lett.*, vol. 41, No. 2 (2005)
- [17] T. Torsti, T. Eirola, J. Enkovaara, T. Hakala, P. Havu, V. Havu, T. Höynälänmaa, J. Ignatius, M. Lyly, I. Makkonen, T. Rantala, J. Ruokolainen, K. Ruotsalainen, E. Räsänen, H. Saarikoski and M. Puska; Three real-space discretization techniques in electronic structure calculations, *Physica Status Solidi (b)*, vol. 243, No. 5, (2006), p. 1016-1053
- [18] J. Hämäläinen, S. Savolainen, R. Wichman, K. Ruotsalainen and J. Ylitalo; On Solution of Scatter Density in Geometry-Based Channel Models, *IEEE Trans. Wireless Comm.*, vol. 6, No. 3, (2007)
- [19] Y. Wu, K. Ruotsalainen and M. Juntti; Unitary Space-Time Constellations Design Based on the Chernoff Bound of the Pairwise Error Probability, *IEEE Trans. Inform. Theory*, vol. 54, No. 8 (2008)
- [20] J. Kemppainen and K. Ruotsalainen; Boundary Integral solution of the time-fractional diffusion equation, *Integr. Eq. Oper. Theory*, vol. 64, pp. 239-249 (2009)



- [21] S.A. Nazarov, K. Ruotsalainen and J. Taskinen; Gaps in the essential spectrum of infinite periodic necklace-shaped elastic waveguide, *Comptes Rendus Mecanique*, vol. 337, issue 2, 2009
- [22] S.A. Nazarov, K. Ruotsalainen and J. Taskinen; Essential spectrum of a periodic elastic waveguide may contain arbitrarily many gaps, *Appl. Anal.*, vol. 90, No.1 (2010), pp.109–124
- [23] J. Kemppainen and K. Ruotsalainen; On the spline collocation method for the single layer equation related to time-fractional diffusion, *Numer. Algor.*, Vol. 56 (2011), DOI: <http://dx.doi.org/10.1007/s11075-010-9430-9>
- [24] Nazarov S.A., Ruotsalainen K. and Taskinen J.; Spectral gaps in the Dirichlet and Neumann problems on the plane perforated by double-periodic family of circular holes (in Russian), *Problems in Mathematical Analysis* 62, pp. 51-100, 2011
- [25] Nazarov S.A., Ruotsalainen K. and Taskinen J.; Spectral gaps in the Dirichlet and Neumann problems on the plane perforated by double-periodic family of circular holes, *Journal of Mathematical Sciences*, Vol. 181, No.2, pp. 164-222, 2012. DOI: 10.1007/s10958-012-0681-y
- [26] G. Cardone, S.A. Nazarov, K. Ruotsalainen; Asymptotics of an eigenvalue in the continuous spectrum of a converging waveguide (in Russian), *Mat. Sbornik*, Vol. 203, No. 2, 2012. (Engl. translation: Asymptotic behaviour of an eigenvalue in the continuous spectrum of a narrowed waveguide, Vol. 203, No. 2)
- [27] Nazarov S.A., Ruotsalainen K. and Taskinen J.; Gaps in the spectrum of the Neumann problem in the perforated plane (in Russian), *Dokl. Russ. Akad. Nauk*. Vol. 444, No. 2, p. 151-156, 2012. (English transl.: *Doklady Mathematics*, 2012, Vol. 86, No.1, pp. 574-578)
- [28] L. Korhonen and K. Ruotsalainen; Diffusion Tracking Algorithm for Image Segmentation, *IGMAP and WINSYS 2012 - Proceedings of the International Conference on Signal Processing and Multimedia Applications and International Conference on Wireless Information Networks and Systems*, Rome, Italy, 24-27 July, 2012.
- [29] G. Cardone, S.A. Nazarov, K. Ruotsalainen; Bound states of a converging quantum waveguide, *ESAIM: Mathematical modelling and Numerical Analysis*, vol. 47, Issue 1 (2013), p. 305-315. (DOI: 10.1051/m2an/2012033)
- [30] F.L. Bakharev, S.A. Nazarov, K. Ruotsalainen; A gap in the spectrum of the Neumann-Laplacian on a singularly perturbed periodic waveguide, *Appl. Anal.*, 92, issue 3, 2013 (<http://dx.doi.org/10.1080/00036811.2012.711819>)

- [31] V. Chiadò Piat, S.A. Nazarov, K. Ruotsalainen; Spectral gaps for water waves above a corrugated bottom, *Proc. Royal Soc. London A* (2012), vol. 469, no. 2149 20120545 (doi: 10.1098/rspa.2012.0545)
- [32] S.A. Nazarov, K. M. Ruotsalainen and P. Uusitalo; The Y-junction of quantum waveguides, *Z. angew. Math. Mech.*, 94(6) 477–486 (2014). doi: 10.1002/zamm.201200255
- [33] Nazarov S.A., Ruotsalainen K.; Criteria for trapped modes in a cranked channel with fixed and freely floating bodies, *Z. Angew. Math. Phys.*, 65 (2014), 977–1002. (DOI:10.1007/s00033-013-0386-1)
- [34] F.L. Bakharev, K. Ruotsalainen, J. Taskinen; Spectral gaps in the spectrum of the problem on surface waves in a periodic channel, *Q J Mechanics Appl Math.*, (2014) 67 (3), 343-362, doi: 10.1093/qjmam/hbu009
- [35] S.A. Nazarov, K. M. Ruotsalainen and P. Uusitalo; Bound states of waveguides with two right-angled bends, *Journal of Math. Phys.*, 56, 021505 (2015); doi: 10.1063/1.4907559.
- [36] Kemppainen J., Nazarov S.A. and Ruotsalainen K. M.; Perturbation analysis of embedded eigenvalues for water waves, *J. Math. Anal. Appl.* (2015), DOI:10.1016/j.jmaa.2015.02.050.
- [37] S.A. Nazarov, K.M. Ruotsalainen, P. Uusitalo; Asymptotics of the spectrum of the Dirichlet Laplacian on a thin carbon nano-structure, *Comptes Rendue Mécanique* (2015), vol. 343, p. 360–364, (DOI: 10.1016/j.crme.2015.03.001)
- [38] S.A. Nazarov, K. M. Ruotsalainen and M. Silvola; Trapped modes under interaction of elastic and electric fields in a piezoelectric waveguide, *Doklady Physics* (2015) 60(10), p. 451-455, (DOI: 10.1134/S1028335815100043)
- [39] S.A. Nazarov and K. M. Ruotsalainen; A rigorous interpretation of approximate computations for embedded eigenfrequencies of water waves, *ZAA* (2016), 35(2), 211–242 (DOI:10.4171/ZAA/1563)
- [40] Nazarov S.A., Ruotsalainen M. and Silvola M.; Trapped modes in piezoelectric and elastic waveguides, *Journal of Elasticity*, Vol. 124, No. 2, pp. 193-223 (2016), DOI 10.1007/s10659-015-9565-y
- [41] V. Chiadò Piat, S.A. Nazarov, K. Ruotsalainen; Spectral gaps and non-Bragg resonances in a water channel, accepted to *Rendiconti dei Linzei* (2016).
- [42] S.A. Nazarov, K. M. Ruotsalainen and P. Uusitalo; Multifarious transmission conditions in the graph models of carbon nano-structures, accepted to *Materials Physics and Mechanics* 2016

[43] S.A. Nazarov, K. M. Ruotsalainen and P. Uusitalo; Localized waves in carbon nano-structures with connected and disconnected open waveguides, accepted to Materials Physics and Mechanics 2016

[44] S.A. Nazarov, K. M. Ruotsalainen and P. Uusitalo; Spectrum of the Dirichlet Laplacian in the hexagonal lattice of thin quantum waveguides, submitted to Comm. Math. Phys.

[45] S.A. Nazarov, K.M. Ruotsalainen and J. Taskinen; Dispersion relations for two-dimensional waveguides, submitted to SIAM Review.

[46] F.L. Bakharev, S.A. Nazarov, K.M. Ruotsalainen and J. Taskinen; Bands in the spectrum of a periodic elastic waveguide, in preparation

### **Refereed articles in conference proceedings and book chapters**

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