

# St. Petersburg Mathematical Journal

(Formerly Leningrad Mathematical Journal)

---

Volume 28 Number 6 December 2017

---

*A Translation of*

РОССИЙСКАЯ АКАДЕМИЯ НАУК

АЛГЕБРА

И

АНАЛИЗ

ТОМ 28 № 6 2016



---

American Mathematical Society

---

Providence, Rhode Island USA

ISSN 1061-0022 (print)

ISSN 1547-7371 (online)

# ST. PETERSBURG MATHEMATICAL JOURNAL

(Formerly Leningrad Mathematical Journal)

*A translation of the Russian bimonthly*

Алгебра и анализ

“Наука”, С.-Петербургское отделение, 2016 г.

**Editor-in-Chief:** S. V. Kislyakov

## Editorial Board

A. B. Aleksandrov	N. Yu. Netsvetaev
A. N. Andrianov	N. K. Nikol'skiĭ
(Deputy Editor-in-Chief)	A. N. Parshin
V. M. Babich	M. A. Semenov-Tyan-Shanskiĭ
A. D. Baranov	A. A. Suslin
(Executive Secretary)	T. A. Suslina
S. V. Buyalo	N. N. Ural'tseva
O. Ya. Viro	(Deputy Editor-in-Chief)
P. P. Kulish	A. L. Chistov
A. V. Mal'yutin	A. V. Yakovlev

**SUBSCRIPTION INFORMATION.** The 2017 subscription is for one volume of six issues. Beginning in 2004, *St. Petersburg Mathematical Journal* is accessible from [www.ams.org/journals/](http://www.ams.org/journals/). Subscription prices for Volume 28 are as follows: for paper delivery, US\$2456 list, US\$1964.80 institutional member; for electronic delivery, US\$2333 list, US\$1866.40 institutional member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add US\$5.50 for delivery within the United States; US\$20 for delivery outside the United States. Subscription renewals are subject to late fees. See [www.ams.org/journal-faq](http://www.ams.org/journal-faq) for more journal subscription information.

**BACK NUMBER INFORMATION.** For back issues see [www.ams.org/backvols](http://www.ams.org/backvols).

Orders for subscriptions and publications of the American Mathematical Society should be addressed to the American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904 USA. *All orders must be accompanied by payment.* Other correspondence should be addressed to 201 Charles Street, Providence, RI 02904-2294 USA.

**COPYING AND REPRINTING.** Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy an article for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgment of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication is permitted only under license from the American Mathematical Society. Permissions to reuse portions of AMS publication content are handled by Copyright Clearance Center's RightsLink® service. For more information, please visit: <http://www.ams.org/rightslink>

Translation rights and licensed reprint requests should be sent to:  
[reprint-permission@ams.org](mailto:reprint-permission@ams.org).

Excluded from these provisions is material in articles for which the author holds copyright. In such cases, requests for permission to use or reprint should be addressed directly to the author(s). (Copyright ownership is indicated in the notice in the lower right-hand corner of the first page of each article.)

**St. Petersburg Mathematical Journal** (ISSN 1061-0022 (print); ISSN 1547-7371 (online)) is published bimonthly by the American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. Periodicals postage paid at Providence, Rhode Island. Postmaster: Send address changes to St. Petersburg Mathematical Journal, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

**Manuscripts** should be addressed to “Algebra i Analiz”, St. Petersburg Publishing Company of the Russian Academy of Sciences, Mendeleevskaya Liniya 1, St. Petersburg 199034, Russia. Submitting simultaneously a tex-file to the address [pmj@pdm1.ras.ru](mailto:pmj@pdm1.ras.ru) is highly appreciated.

© 2017 American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews* and *Zentralblatt MATH*.

This journal is archived in *Portico* and in *CLOCKSS*.

Translation authorized by the All-Union Agency for Author's Rights, Moscow.

Printed in the United States of America.

⊗ The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability.

10 9 8 7 6 5 4 3 2 1      22 21 20 19 18 17

# St. Petersburg Mathematical Journal

---

Volume 28 Number 6 December 2017

---

*A Translation of*

РОССИЙСКАЯ АКАДЕМИЯ НАУК

## АЛГЕБРА И АНАЛИЗ

ТОМ 28 № 6 2016



---

American Mathematical Society

---

Providence, Rhode Island USA

ISSN 1061-0022 (print)

ISSN 1547-7371 (online)

# ST. PETERSBURG MATHEMATICAL JOURNAL

(Formerly Leningrad Mathematical Journal)

*A translation of the Russian bimonthly*

Алгебра и анализ

“Наука”, С.-Петербургское отделение, 2016 г.

**Editor-in-Chief:** S. V. Kislyakov

## Editorial Board

A. B. Aleksandrov	N. Yu. Netsvetaev
A. N. Andrianov	N. K. Nikol'skiĭ
(Deputy Editor-in-Chief)	A. N. Parshin
V. M. Babich	M. A. Semenov-Tyan-Shanskiĭ
A. D. Baranov	A. A. Suslin
(Executive Secretary)	T. A. Suslina
S. V. Buyalo	N. N. Ural'tseva
O. Ya. Viro	(Deputy Editor-in-Chief)
P. P. Kulish	A. L. Chistov
A. V. Malyyutin	A. V. Yakovlev

**SUBSCRIPTION INFORMATION.** The 2017 subscription is for one volume of six issues. Beginning in 2004, *St. Petersburg Mathematical Journal* is accessible from [www.ams.org/journals/](http://www.ams.org/journals/). Subscription prices for Volume 28 are as follows: for paper delivery, US\$2456 list, US\$1964.80 institutional member; for electronic delivery, US\$2333 list, US\$1866.40 institutional member. Upon request, subscribers to paper delivery of this journal are also entitled to receive electronic delivery. If ordering the paper version, add US\$5.50 for delivery within the United States; US\$20 for delivery outside the United States. Subscription renewals are subject to late fees. See [www.ams.org/journal-faq](http://www.ams.org/journal-faq) for more journal subscription information.

**BACK NUMBER INFORMATION.** For back issues see [www.ams.org/backvols](http://www.ams.org/backvols).

Orders for subscriptions and publications of the American Mathematical Society should be addressed to the American Mathematical Society, P.O. Box 845904, Boston, MA 02284-5904 USA. *All orders must be accompanied by payment.* Other correspondence should be addressed to 201 Charles Street, Providence, RI 02904-2294 USA.

**COPYING AND REPRINTING.** Individual readers of this publication, and nonprofit libraries acting for them, are permitted to make fair use of the material, such as to copy an article for use in teaching or research. Permission is granted to quote brief passages from this publication in reviews, provided the customary acknowledgment of the source is given.

Republication, systematic copying, or multiple reproduction of any material in this publication is permitted only under license from the American Mathematical Society. Permissions to reuse portions of AMS publication content are handled by Copyright Clearance Center's RightsLink® service. For more information, please visit: <http://www.ams.org/rightslink>

Translation rights and licensed reprint requests should be sent to:

[reprint-permission@ams.org](mailto:reprint-permission@ams.org).

Excluded from these provisions is material in articles for which the author holds copyright. In such cases, requests for permission to use or reprint should be addressed directly to the author(s). (Copyright ownership is indicated in the notice in the lower right-hand corner of the first page of each article.)

**St. Petersburg Mathematical Journal** (ISSN 1061-0022 (print); ISSN 1547-7371 (online)) is published bimonthly by the American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA. Periodicals postage paid at Providence, Rhode Island. Postmaster: Send address changes to St. Petersburg Mathematical Journal, American Mathematical Society, 201 Charles Street, Providence, RI 02904-2294 USA.

**Manuscripts** should be addressed to “Algebra i Analiz”, St. Petersburg Publishing Company of the Russian Academy of Sciences, Mendeleevskaya Liniya 1, St. Petersburg 199034, Russia. Submitting simultaneously a tex-file to the address [pmj@pdm1.ras.ru](mailto:pmj@pdm1.ras.ru) is highly appreciated.

© 2017 American Mathematical Society. All rights reserved.

This journal is indexed in *Mathematical Reviews* and *Zentralblatt MATH*.

This journal is archived in *Portico* and in *CLOCKSS*.

Translation authorized by the All-Union Agency for Author's Rights, Moscow.

Printed in the United States of America.

⊗ The paper used in this journal is acid-free and falls within the guidelines established to ensure permanence and durability.

10 9 8 7 6 5 4 3 2 1      22 21 20 19 18 17

## CONTENTS

### Research Papers

A. Davydow, New algorithms for solving tropical linear systems .....	727
V. E. Ismailov, Approximation by sums of ridge functions with fixed directions	741
N. Nikolski, Numerically detectable hidden spectrum of certain integration operators .....	773
F. Petrov, Correcting continuous hypergraphs .....	783
D. V. Rutsky, Vector-valued boundedness of harmonic analysis operators .....	789
E. A. Sevost'yanov, Local and boundary behavior of maps in metric spaces ...	807
A. L. Chistov, Extension of the Newton–Puiseux algorithm to the case of a nonzero characteristic ground field. I .....	825
N. A. Shirokov, On means with power $-2$ for the dervatives of functions of class $S$ .....	855

## RUSSIAN CONTENTS\*

### СОДЕРЖАНИЕ

#### Статьи

<i>Davydov A.</i> New algorithms for solving tropical linear systems	1
<i>Исмаилов В. Э.</i> Аппроксимация суммами ридж функций с фиксированными направлениями . . . . .	20
<i>Nikolski N.</i> Numerically detectable hidden spectrum of certain integration operators . . . . .	70
<i>Петров Ф.</i> Исправление непрерывных гиперграфов . . . . .	84
<i>Руцкий Д. В.</i> Векторнозначная ограниченность операторов гармонического анализа . . . . .	91
<i>Севостьянов Е. А.</i> О локальном и граничном поведении отображений в метрических пространствах . . . . .	118
<i>Чистов А. Л.</i> Расширение алгоритма Ньютона–Пюизе на случай ненулевой характеристики основного поля. I. . . . .	147
<i>Широков Н. А.</i> О средних степени $-2$ производных в классе $S$ . . . . .	189
Именной указатель журнала «Алгебра и анализ», т. 28, 2016 г.	208

---

\*The American Mathematical Society scheme for transliteration of Cyrillic may be found at the end of index issues of *Mathematical Reviews*.

## AUTHOR INDEX

- Abdulnagimov, A. I., and A. S. Krivosheyev. *Regularly distributed subsets in the complex plane*, 433
- Alekhno, E., E. Semenov, F. Sukochev, and A. Usachev. *Order and geometric properties of the set of Banach limits*, 299
- Astashkin, S. V., and K. V. Lykov. *Sparse Rademacher chaos in symmetric spaces*, 1
- Baĭguskarov, T. Yu., G. R. Talipova, and B. N. Khabibullin. *Subsequences of zeros for classes of entire functions of exponential type distinguished by growth restrictions*, 127
- Bak, A., and A. Stepanov. *Subring subgroups of symplectic groups in characteristic 2*, 465
- Bakharev, F. L., S. G. Matveenko, and S. A. Nazarov. *The discrete spectrum of cross-shaped waveguides*, 171
- Bandle, C., and A. Wagner. *Domain perturbations for elliptic problems with Robin boundary conditions of opposite sign*, 153
- Berestovskii, V. N., and I. A. Zubareva. *Sub-Riemannian distance on the Lie group  $SO_0(2, 1)$* , 477
- Bien, M. H. *See* Ngoc, N. K.
- Buyalo, S. *Möbius and sub-Möbius structures*, 555
- Chepurkin, K. *Injectivity theorem for homotopy invariant presheafs with Witt-transfers*, 291
- Chistov, A. L. *Extension of the Newton–Puiseux algorithm to the case of a nonzero characteristic ground field. I*, 825
- Davydow, A. *New algorithms for solving tropical linear systems*, 727
- Dubashinskiy, M. B. *Interpolation by periods in a planar domain*, 597
- Evdokimov, S., and I. Ponomarenko. *On the separability problem for circulant  $S$ -rings*, 21
- Gurevich, P. *Asymptotics of parabolic Green’s functions on lattices*, 569
- Hai, B. X. *See* Ngoc, N. K.
- Havin, V. P. *See* Mozolyako, P.
- Isaev, K. P., R. S. Yulmukhametov, and A. A. Yunusov. *On unconditional bases of exponentials in weighted spaces on an interval of the real axis*, 689
- Ishkin, Kh. K. *Localization criterion for the spectrum of the Sturm–Liouville operator on a curve*, 37
- Ismailov, V. E. *Approximation by sums of ridge functions with fixed directions*, 741
- Ivanova, O. A., and S. N. Melikhov. *On operators commuting with a Pommiez type operator in weighted spaces of entire functions*, 209

- Khabibullin, B. N. See Baĭguskarov, T. Yu.
- Korikov, D. V., and B. A. Plamenevskiĭ. *Asymptotics of solutions of the stationary and nonstationary Maxwell systems in a domain with small cavities*, 507
- Krivoshain, A. V. *Symmetric interpolatory dual wavelet frames*, 323
- Krivosheyev, A. S. See Abdalnagimov, A. I.
- Kukushkin, A. A., and T. A. Suslina. *Homogenization of high order elliptic operators with periodic coefficients*, 65
- Lykov, K. V. See Astashkin, S. V.
- Makarov, B. M., and A. N. Podkorytov. *On the coordinate functions of Peano curves*, 115
- Matveenko, S. G. See Bakharev, F. L.
- Melikhov, S. N. See Ivanova, O. A.
- Mozolyako, P., and V. P. Havin. *Boundedness of a variation of the positive harmonic function along the normals to the boundary*, 345
- Nazarov, S. A. *Almost standing waves in a periodic waveguide with resonator, and near-threshold eigenvalues*, 377
- . See Bakharev, F. L.
- Ngoc, N. K., M. H. Bien, and B. X. Hai. *Free subgroups in almost subnormal subgroups of general skew linear groups*, 707
- Nikolski, N. *Numerically detectable hidden spectrum of certain integration operators*, 773
- Ohrysko, P., and M. Wojciechowski. *Spectrally reasonable measures*, 259
- Orevkov, S. Yu., and E. I. Shustin. *Real algebraic and pseudoholomorphic curves on the quadratic cone and smoothings of the singularity  $X_{21}$* , 225
- Osipov, N. N. *Littlewood–Paley–Rubio de Francia inequality for the Walsh system*, 719
- Pastukhova, S. E. *Operator error estimates for homogenization of fourth order elliptic equations*, 273
- Petrov, F. *Correcting continuous hypergraphs*, 783
- Petrov, V. *Decomposition of transvections: An algebro-geometric approach*, 109
- Plamenevskiĭ, B. A. See Korikov, D. V.
- Podkorytov, A. N. See Makarov, B. M.
- Ponomarenko, I. See Evdokimov, S.
- Rutsky, D. V. *Vector-valued boundedness of harmonic analysis operators*, 789
- Semenov, E. See Alekhno, E.
- Sevost'yanov, E. A. *Local and boundary behavior of maps in metric spaces*, 807
- Shirokov, N. A. *On means with power  $-2$  for the derivatives of functions of class  $S$* , 855
- Shustin, E. I. See Orevkov, S. Yu.
- Slavin, L., and V. Vasyunin. *The John–Nirenberg constant of  $BMO^p$ ,  $p > 2$* , 181
- Stepanov, A. *A new look at the decomposition of unipotents and the normal structure of Chevalley groups*, 411
- . See Bak, A.
- Sukochev, F. See Alekhno, E.
- Suslina, T. A. See Kukushkin, A. A.



- Talipova, G. R. *See* Baĭguskarov, T. Yu.
- Usachev, A. *See* Alekhno, E.
- Vasyunin, V. *See* Slavin, L.
- Wagner, A. *See* Bandle, C.
- Wojciechowski, M. *See* Ohrysko, P.
- Yakerson, Maria. *Algebraic K-theory of the varieties  $SL_{2n}/Sp_{2n}$ ,  $E_6/F_4$  and their twisted forms*, 421
- Yulmukhametov, R. S. *See* Isaev, K. P.
- Yunusov, A. A. *See* Isaev, K. P.
- Zakharov, A. S. *See* Zhelyabin, V. N.
- Zhelyabin, V. N., and A. S. Zakharov. *Some constructions for Jordan superalgebras with associative even part*, 197
- Zhuravlev, V. G. *Symmetrization of bounded remainder sets*, 491
- . *Induced bounded remainder sets*, 671
- Zubareva, I. A. *See* Berestovskii, V. N.

# St. Petersburg Mathematical Journal

---

Volume 28 Numbers 1–6 2017

---

*A Translation of*

РОССИЙСКАЯ АКАДЕМИЯ НАУК

## АЛГЕБРА И АНАЛИЗ

ТОМ 28 №№ 1–6 2016



---

American Mathematical Society

---

Providence, Rhode Island USA

ISSN 1061-0022 (print)

ISSN 1547-7371 (online)

**St. Petersburg Mathematical Journal**  
**(Formerly Leningrad Mathematical Journal)**

**CONTENTS**

**Volume 28, Number 1, 2017**

**Research Papers**

S. V. Astashkin and K. V. Lykov, <a href="#">Sparse Rademacher chaos in symmetric spaces</a> .....	1
S. Evdokimov and I. Ponomarenko, <a href="#">On the separability problem for circulant S-rings</a> .....	21
Kh. K. Ishkin, <a href="#">Localization criterion for the spectrum of the Sturm–Liouville operator on a curve</a> .....	37
A. A. Kukushkin and T. A. Suslina, <a href="#">Homogenization of high order elliptic operators with periodic coefficients</a> .....	65
V. Petrov, <a href="#">Decomposition of transvections: An algebro-geometric approach</a> ....	109

**Easy Reading for Professionals**

B. M. Makarov and A. N. Podkorytov, <a href="#">On the coordinate functions of Peano curves</a> .....	115
-------------------------------------------------------------------------------------------------------	-----

**Volume 28, Number 2, 2017**

**Research Papers**

T. Yu. Baĭguskarov, G. R. Talipova, and B. N. Khabibullin, <a href="#">Subsequences of zeros for classes of entire functions of exponential type distinguished by growth restrictions</a> .....	127
C. Bandle and A. Wagner, <a href="#">Domain perturbations for elliptic problems with Robin boundary conditions of opposite sign</a> .....	153
F. L. Bakharev, S. G. Matveenko, and S. A. Nazarov, <a href="#">The discrete spectrum of cross-shaped waveguides</a> .....	171
L. Slavin and V. Vasyunin, <a href="#">The John–Nirenberg constant of <math>BMO^p</math>, <math>p &gt; 2</math></a> ...	181
V. N. Zhelyabin and A. S. Zakharov, <a href="#">Some constructions for Jordan superalgebras with associative even part</a> .....	197
O. A. Ivanova and S. N. Melikhov, <a href="#">On operators commuting with a Pommiez type operator in weighted spaces of entire functions</a> .....	209
S. Yu. Orevkov and E. I. Shustin, <a href="#">Real algebraic and pseudoholomorphic curves on the quadratic cone and smoothings of the singularity <math>X_{21}</math></a> .....	225
P. Ohrysko and M. Wojciechowski, <a href="#">Spectrally reasonable measures</a> .....	259
S. E. Pastukhova, <a href="#">Operator error estimates for homogenization of fourth order elliptic equations</a> .....	273
K. Chepurkin, <a href="#">Injectivity theorem for homotopy invariant presheafs with Witt-transfers</a> .....	291

## Volume 28, Number 3, 2017

### Research Papers

E. Alekhno, E. Semenov, F. Sukochev, and A. Usachev, Order and geometric properties of the set of Banach limits .....	299
A. V. Krivoshein, Symmetric interpolatory dual wavelet frames .....	323
P. Mozolyako and V. P. Havin, Boundedness of a variation of the positive harmonic function along the normals to the boundary .....	345
S. A. Nazarov, Almost standing waves in a periodic waveguide with resonator, and near-threshold eigenvalues .....	377
A. Stepanov, A new look at the decomposition of unipotents and the normal structure of Chevalley groups .....	411
Maria Yakerson, Algebraic K-theory of the varieties $SL_{2n}/Sp_{2n}$ , $E_6/F_4$ and their twisted forms .....	421

## Volume 28, Number 4, 2017

### Research Papers

A. I. Abdalnagimov and A. S. Krivosheyev, Regularly distributed subsets in the complex plane .....	433
A. Bak and A. Stepanov, Subring subgroups of symplectic groups in characteristic 2 .....	465
V. N. Berestovskii and I. A. Zubareva, Sub-Riemannian distance on the Lie group $SO_0(2, 1)$ .....	477
V. G. Zhuravlev, Symmetrization of bounded remainder sets .....	491
D. V. Korikov and B. A. Plamenevskii, Asymptotics of solutions of the stationary and nonstationary Maxwell systems in a domain with small cavities .....	507

## Volume 28, Number 5, 2017

### Research Papers

S. Buyalo, Möbius and sub-Möbius structures .....	555
P. Gurevich, Asymptotics of parabolic Green's functions on lattices .....	569
M. B. Dubashinskiy, Interpolation by periods in a planar domain .....	597
V. G. Zhuravlev, Induced bounded remainder sets .....	671
K. P. Isaev, R. S. Yulmukhametov, and A. A. Yunusov, On unconditional bases of exponentials in weighted spaces on an interval of the real axis .....	689
N. K. Ngoc, M. H. Bien, and B. X. Hai, Free subgroups in almost subnormal subgroups of general skew linear groups .....	707
N. N. Osipov, Littlewood–Paley–Rubio de Francia inequality for the Walsh system .....	719

Research Papers

A. Davydow, <a href="#">New algorithms for solving tropical linear systems</a> .....	727
V. E. Ismailov, <a href="#">Approximation by sums of ridge functions with fixed directions</a> .....	741
N. Nikolski, <a href="#">Numerically detectable hidden spectrum of certain integration operators</a> .....	773
F. Petrov, <a href="#">Correcting continuous hypergraphs</a> .....	783
D. V. Rutsky, <a href="#">Vector-valued boundedness of harmonic analysis operators</a> .....	789
E. A. Sevost'yanov, <a href="#">Local and boundary behavior of maps in metric spaces</a> ...	807
A. L. Chistov, <a href="#">Extension of the Newton–Puiseux algorithm to the case of a nonzero characteristic ground field. I</a> .....	825
N. A. Shirokov, <a href="#">On means with power <math>-2</math> for the dervatives of functions of class <math>S</math></a> .....	855





1061-0022(201712)28:6\*;1-U