MATEMAATIKA-LOODUSTEADUSKONNA MATEMAATIKAINSTITUUDI TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2011

1. Instituudi struktuur

Instituudi direktor Jaan Janno

- Algebra ja geomeetria õppetool, Chair of Algebra and Geometry, Peeter Puusemp
- Matemaatilise analüüsi õppetool, Chair of Mathematical Analysis, Ivar Tammeraid
- Matemaatilise füüsika õppetool, Chair of Mathematical Physics, Eugen Paal
- Rakendusmatemaatika õppetool, Chair of Applied Mathematics, Jaan Janno

2. Instituudi teadus- ja arendustegevuse (edaspidi T&A) iseloomustus

(NB! punktid 2.1- 2.6 täidab struktuuriüksus)

2.1 struktuuriüksuse koosseisu kuuluvate uurimisgruppide

2.1.1 teadustöö kirjeldus *(inglise keeles*);

- *Chair of Algebra and Geometry* The main topic of the studies is group and semigroup theory
- *Chair of Mathematical Analysis* The main topics are summability theory and sampling operators with applications in imaging
- *Chair of Applied Mathematics* The main topics are inverse problems, integraal equations and methods of mathematical statistics
- *Chair of Mathematical Physics* The main topics are applied representation , in particular operad and deformation theoretical applications in mathematical physics

2.1.2 aruandeaastal saadud tähtsamad teadustulemused *(inglise keeles).*

- *Chair of Algebra and Geometry* Investigations on endomorphisms monoids of quasigroups were continued. The class of quasigroups is a large subclass of the algebraic structures with an unary operation. All groups are contained also in this class. Since the class of quasigroups is very large, it is studied mainly some its subclasses. One of such classes is the class of all medial quasigroups. The binary operation in a medial quasigroup is defined using the operation of a certain Abelian group and its automorphisms. Therefore, the aim was to use some earlier results on endomorphism semigroups of Abelian groups for studiying the endomorphism semigroups of medial quasigroups. It was proved that each commutative idempotent medial quasigroup is determined by its endomorphism semigroup in the class of all commutative idempotent medial quasigroups. (A. Leibak, P. Puusemp). Investigations on endomorphism semigroups of semigroups were started. It is possible only for certain classes of semigroups, because the connection between a semigroup and its endomorphism semigroup is usually weak. The class of Clifford semigroups was choosed and described some types of Clifford semigroups by their endomrphism semigroups. (P. Puusemp).

- *Chair of Mathematical Analysis* Several new Tauberian remainder theorems for the (C,1) method of summability using the general control modulo of the oscillatory behavior were proved (I. Tammeraid, O. Meronen). These theorems give the remainders for the Tauberian theorems proved previously by E. Landau, M. Dik, I. Canak and Ü. Totur. Sampling operators, defined using an even bandlimited kernel function, were considered. It was showed that the truncation error, which is introduced for some bandlimited kernels finite sums instead of the sampling series, decreases so fast that in practice there is not so much difference in the application of either the kernels with finite support or rapidly decreasing bandlimited kernels. Moreover, truncation error of some generalized sampling series wes studied and exact values of operator norms of truncation error for those sampling series were found. In addition, some sampling operators with averaged kernels for functions of bounded variation, which are natural choice for representing images, were investigated, and it was showed that in those cases we have variation detracting property. The study of approximation properties of averaged kernels was started.
- *Chair of Applied Mathematics* Inverse problems to determine free terms of parabolic integro-differential equations by means of instant and integraal measurements of temperature were studied in the weak formulation. A general method to deduce the adjoint problems was elaborated (J. Janno, K. Kasemets). The technique of two distribution functions approximation was developped. The Edgeworth type of expansion was generalized from two-dimensional case to three-dimensional case. The results of multivariate statisics were applied on different environmaental datas. These results of applications are planned to publish in several year (M. Pihlak).
- *Chair of Mathematical Physics* The Jacobi operators of quantum counterparts of 3d real Lie algebras in Bianchi classification ove the harmonic oscillato were calculated An operadic Lax representation of a real 2d Lie algebra were found over the harmonic oscillator. Systematized and generalized earlier results about various kinds of structures, such as Poisson, Lie-admissible flexible, Novikov on current and related (matrix algebras over nonassociative rings, Kac-Moody, modular semisimple) Lie algebras. Discovered that many Lie algebras, appearing in such disjoint areas as structure theory of modular Lie algebras, K-theory, and physics, admit a unifying description: they are Lie algebras obtained from the tensor product of algebras over dual binary quadratic operads. In particular, a lot of algebras appearing as symmetries of physical theories arise in this way from the pair of operads, such as right Novikov, left Novikov. An approach, developed by me earlier for computations of low-dimensional cohomology and other invariants of current Lie algebras, what corresponds to the pair of operads, e.g. Lie, Comm, could be extended to this more general situation. Developed approach to classification of simple Novikov superalgebras, based on commutative 2-cocycles of Lie superalgebras (E. Paal, P. Zusmanovich).

2.2 Uurimisgrupi kuni 5 olulisemat publikatsiooni läinud aastal.

- *Chair of Algebra and Geometry*

    1) Leibak, A.; Puusemp, P. (2011). On determinability of idempotent medial commutative quasigroups by their endomorphism semigroups. Proceedings of the Estonian Academy of Sciences, 60(2), 81 - 87.

    2) Puusemp, P. (2011). Endomorphisms and Endomorhism Semigroups of Groups. Jacob H. Mathias (Toim.). Mathematics, Game Theory and Algebra Compendium (445 - 471).Nova Science Publishers

- *Chair of Mathematical Analysis*

    1) Tamberg, G. (2011). Exact values of truncation errors for generalized sampling operators. Andy W. H. Khong, Frederique Oggier (Toim.). Proceedings of 9th International Conference on Sampling Theory and Applications 2 -6 May 2011 Nanyang Technological University, Singapore (1 - 4). Singapore: Nanyang Technological University

- *Chair of Applied Mathematics*

    1) von Wolfersdorf, Lothar; Janno, Jaan (2011). Integro-differential equations of first order with auto-convolution integral II. Journal of Integral Equations and Applications, 23(2), 331 - 349.

    2) Kasemets, K.; Janno, J. (2011). Reconstruction of a Source Term in a Parabolic Integro-Differential Equation from Final Data . Mathematical Modelling and Analysis, 16(2), 199 - 219.

    3) Pihlak, M. (2011). Using Edgeworth expansion approximating two- and three dimensional probability distribution functions. 2011 World Congress on Engineering and Technology (CET) Oct, 28-Nov, 2 2011 Shanghai, China. IEEE, 2011.

- *Chair of Mathematical Physics*

    1) Zusmanovich, P. (2011). How Euler would compute the Euler-Poincaré characteristic of a Lie superalgebra. Expositiones Mathematicae, 29(3), 345 - 360.
    2) P. Zusmanovich (with A. Dzhumadil'daev). The alternative operad is not Koszu. Experimental Mathematics, 20 (2011), 138-144.
    3) P. Zusmanovich. Non-existence of invariant symmetric forms on generalized Jacobson-Witt algebras revisited. Comm. Algebra, 39 (2011), 548-554.

    4) Paal, E.; Virkepu, J. (2011). Jacobi operators of quantum counterparts of three-dimensional real Lie algebras over the harmonic oscillator. Banach Center Publications (199 - 209). Warszawa: Polish Acad Sciences Inst Mathematics

    5) E. Paal (with V. Abramov, J. Fuchs, A. Stolin, A. Tralle, P. Urbanski), Eds. Algebra, Geometry and Mathematical Physics. Banach Center. Publ. 93, 2011.

2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustustest.

2.4 Loetelu struktuuriüksuse töötajatest, kes on välisakadeemiate või muude oluliste T&A-ga seotud välisorganisatsioonide liikmed.

- J. Janno ja P. Puusemp on Ameerika Matemaatikaühingu liikmed
- J. Janno, P. Puusemp, I. Tammeraid, M. Pihlak ja G. Tamberg on Eesti Matemaatika Seltsi liikmelisuse kaudu Euroopa Matemaatika Seltsi liikmed.

2.5 Aruandeaasta tähtsamad T&A finantseerimise allikad.

T011, ETF7656, ERMOS7

2.6 Soovi korral lisada aruandeaastal saadud T&A-ga seotud tunnustusi (va punktis 2.3 toodud tunnustused), ülevaate teaduskorralduslikust tegevusest, teadlasmobiilsusest ning anda hinnang oma teadustulemustele.

- E. Paal on ajakirjade (Ashdin Publisher) Journal of Generalized Lie Theory and Applications ja Journal of Physical Mathematics peatoimetaja
- J. Janno on ajakirjade Mathematical Modelling and Analysis ja The Open Acoustics Journal toimetuskolleegiumite liige
- J. Janno on ETF ekspertkomisjoni liige
- Matemaatilise füüsika õppetool osaleb võrgustiku AGMP (Algebra, Geometry, Mathematical Physics) tegevuses (vt http://www.agmp.eu). Võrgustik haarab kontakte EU riikides, USAs, Jaapanis, Brasiilias. E. Paal on väljaande AGMP Proceedings toimetaja.
- Rakendusmatemaatika õppetool osaleb konverentsivõrgustiku Mathematical Modelling and Analysis töös.

2.7 Instituudi teadus- ja arendustegevuse teemade ja projektide nimetused *(Eesti Teadusinfosüsteemi, edaspidi ETIS, andmetel)*

- Haridus- ja Teadusministeerium

sihtfinantseeritavad teemad:

– T011, Algebra ja analüüsi kaasaegsed rakendusmeetodid diferentsiaal- ja integraalvõrrandite teoorias, matemaatilises füüsikas ja statistikas, Puusemp Peeter

baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):
riiklikud programmid:

- Teiste ministeeriumide poolt rahastatavad riiklikud programmid:
- Uurija-professori rahastamine:
- SA Eesti Teadusfond

grandid:

– ETF7656, Mitmemõõtmelised jaotused ja nende rakendused, Pihlak Margus

ühisgrandid välisriigiga:
järeldoktorite grandid (SA ETF ja Mobilitas):

– ERMOS7, Lie algebrate kohomoloogia, mitteassotsiatiivsed struktuurid, dünaamilised süsteemid ja operaadid, Zusmanovich Pasha
– ERMOS83, Kvant-Harish_Chandra moodulite geomeetrilised realisatsioonid, mittekommutatiivne kompleks ja harmooniline analyys, Bershtein Olya

tippteadlase grandid (Mobilitas):

- Ettevõtluse Arendamise SA

eeluuringud:
arendustoetused:

- SA Archimedesega sõlmitud lepingud

infrastruktuur (nn „mini-infra“, „asutuse infra“):
Eesti tippkeskused:
riiklikud programmid:
muud T&A lepingud:

- SA Keskkonnainvesteeringute Keskusega sõlmitud lepingud:
- Siseriiklikud lepingud:
- EL Raamprogrammi projektid:
- Välisriiklikud lepingud:

2.8 Struktuuriüksuse töötajate poolt avaldatud sihtfinantseeritava teadusteema taotlemisel arvestatavad eelretsenseeritavad teaduspublikatsioonid *(ETIS klassifikaatori alusel 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1 ja 5.1).*

1.1

Zusmanovich, P. (2011). How Euler would compute the Euler-Poincaré characteristic of a Lie superalgebra. Expositiones Mathematicae, 29(3), 345 - 360.

P. Zusmanovich (with A. Dzhumadil'daev). The alternative operad is not Koszu. Experimental Mathematics, **20** (2011), 138-144.

P. Zusmanovich. Non-existence of invariant symmetric forms on generalized Jacobson-Witt algebras revisited. Comm. Algebra, **39** (2011), 548-554.

von Wolfersdorf, Lothar; Janno, Jaan (2011). Integro-differential equations of first order with auto-convolution integral II. Journal of Integral Equations and Applications, 23(2), 331 - 349.

Leibak, A.; Puusemp, P. (2011). On determinability of idempotent medial commutative quasigroups by their endomorphism semigroups. Proceedings of the Estonian Academy of Sciences, 60(2), 81 - 87.

Kasemets, K.; Janno, J. (2011). Reconstruction of a Source Term in a Parabolic Integro-Differential Equation from Final Data . Mathematical Modelling and Analysis, 16(2), 199 - 219.

1.2

1.3

2.1

2.2

3.1

Puusemp, P. (2011). Endomorphisms and Endomorhism Semigroups of Groups. Jacob H. Mathias (Toim.). Mathematics, Game Theory and Algebra Compendium (445 - 471).Nova Science Publishers

Pihlak, M. (2011). Using Edgeworth expansion approximating two- and three dimensional probability distribution functions. 2011 World Congress on Engineering and Technology (CET) Oct,

28-Nov, 2 2011 Shanghai, China. IEEE, 2011.

3.2

Paal, E.; Virkepu, J. (2011). Jacobi operators of quantum counterparts of three-dimensional real Lie algebras over the harmonic oscillator. Banach Center Publications (199 - 209). Warszawa: Polish Acad Sciences Inst Mathematics

Kurvits, Jüri (2011). Proportsionaalse mõtlemise areng. In: Koolimatemaatika 38: XXXVIII Eesti matemaatikaõpetajate päevad, Rakvere, 11.-12. november 2011. (Toim.) Elts Abel, Katrin Kokk. Tartu: Tartu Ülikooli Kirjastus, 2011, 34 - 39.

E. Paal (with J. Virkepu). 2D binary operadic Lax representation for harmonic oscillator. In “Noncommutative Structures in Mathematics and Physics”. S. Caenepeel, J. Fuchs, S. Gutt, C. Schweigert, A. Stolin, F. Van Oyestayen, Eds. KVAB, Brussel, 2010.

3.3

3.4

Belikov, J.; Kotta, Ü.; Leibak, A. (2011). Transfer matrix and its Jacobson form for nonlinear systems on time scales: Mathematica implementation. *In: Full Papers : 18th International Conference on Process Control '11 : June 14-17, 2011, Tatransk Lomnica, Slovakia: (Toim.) Fikar, M.; Kvasnica, M.*. Bratislava: Slovak University of Technology, 2011, 141 - 146.

Tamberg, G. (2011). Exact values of truncation errors for generalized sampling operators. Andy W. H. Khong, Frederique Oggier (Toim.). Proceedings of 9th International Conference on Sampling Theory and Applications 2 -6 May 2011 Nanyang Technological University, Singapore (1 - 4). Singapore: Nanyang Technological University

4.1

E. Paal (with V. Abramov, J. Fuchs, A. Stolin, A. Tralle, P. Urbanski), Eds. Algebra, Geometry and Mathematical Physics. Banach Center. Publ. **93**, 2011.

Deformation Theory and Applications. E. Paal (with A. Makhlouf, A. Stolin), Eds. J. Gen. Lie Theory Appl. vol 5, 2011

5.1

2.9 Struktuuriüksuses kaitstud doktoriväitekirjade loetelu *(NB! struktuuriüksus lisab struktuuriüksuse töötaja juhendamisel mujal kaitstud doktoriväitekirjade loetelu)*

2.10 Struktuuriüksuses järeldoktorina T&A-s osalenud isikute loetelu *(ETIS-e kaudu esitatud taotluste alusel)*

ERMOS7, Lie algebrate kohomoloogia, mitteassotsiatiivsed struktuurid, dünaamilised süsteemid ja operaadid, Zusmanovich Pasha

ERMOS83, Kvant-Harish_Chandra moodulite geomeetrilised realisatsioonid, mittekommutatiivne kompleks ja harmooniline analyys, Bershtein Olya

2.11 Struktuuriüksuses loodud tööstusomandi loetelu

3. Struktuuriüksuse infrastruktuuri uuendamise loetelu