

**Report on scientific and scientific-organization activity of
“Optimal Control” department for 2017.**

“Optimal Control” department consists 9 research associates, 6 of them doctor of sciences, professor, including two corr.-member of ANAS.

1. Misir Mardanov - head of department (corr.-member of ANAS)
2. Telman Melikov-senior research associate
3. Kamil Ayda-zadeh- senior research associate (corr.-member of ANAS)
4. Ramiz Aslanov- senior research associate
5. Hamlet Guliyev - senior research associate
6. Ramin Rzayev-leading research associate
7. Yusif Gasimov- leading research associate
8. One philosophy doctor in mathematics: Eldar Mammadov-leading research associate.
9. One candidate for a degree: Samin Malik – junior res. ass.

In 2017, 2 books, 1 monograph, 25 papers (12 of them in Thompson Reuters journals) and 7 abstracts of the department collaborators were published.

The scientific research works were conducted in three directions.

- I. Mathematical methods of optimal control.**
- II. Development of analytic-information system based on Soft Commuting technology supporting planning, synthesis and execution of decisions under uncertainty conditions.**
- III. History and methodology of mathematics.**

I. Mathematical methods of optimal control.

1.1 WORK: “Necessary conditions for the optimality of problems in continuous and discrete systems”.

Authors: Prof. Misir J. Mardanov, Prof. Telman K. Melikov.

Optimal control of continuous processes described by delay control functions. In a result, renewed variant of transformation of variation space was introduced ad different type higher order conditions for optimality were obtained.

1.1 One research work has been reflected in the following papers

1. Misir J.Mardanov, Telman K.Melikov. Analogue of the Kelley condition for optimal systems with retarded control. International Journal of Control, 2017, pages 1-9 (IF=1.880). T. R. 19. Volume: 90 Issue: 7 Pages: 1299-1307

2. М.Дж.Марданов, Т.К.Меликов, “К Теории Особых Оптимальных Управлений В Динамических Системах с Запаздыванием В Управлении” Журнал вычислительной математики и математической физики, 2017, том 57, № 5, с. 1–22 T. R. 24.

3. Misir J. Mardanov, Telman K. Melikov, New second order necessary optimality conditions for discrete control problem. Materials of Scientific Conference “Actual problems of Mathematics and Mechanics” dedicated to the 100th jubilee of Goshgar Ahmedov. 02-03 november 2017, p. 89.

4. Misir J. Mardanov, Telman K. Melikov, New discrete analogue of Pontryagin’s maximum principle // International Conference “Modern problems of Mathematics and Mechanics” dedicated to the 80th jubilee of Akif Hajiyev. 6-8 december, 2017.

5. Mardanov M.J., Melikov T.K., Mamedov E.Sh. “The second order necessary conditions for a strong minimum in problems of classical calculus of variations”, Materials of “Theoretical and Practical Problems of Mathematics” International Scientific Conference, Sumgait 2017, p. 201.

6. М.Дж. Марданов, Т.К.Меликов, Мамедов Э.Ш., О числовой области одного класса двухпараметрической спектральной задачи, Materials of Scientific Conference “Actual problems of Mathematics and Mechanics” dedicated to the 100th jubilee of Goshgar Ahmedov. 02-03 november 2017, p 222-223

7. М.Дж.Марданов, Т.К.Меликов, С.С.Шагаватова, «Линеаризованные условия оптимальности в дискретных системах с запаздыванием в управлении», International Scientific Conference “Theoretical and applied problems of mathematics” Sumgait 2017, pp.235.

1.2 Work “Optimal control problem of moving sources for a parabolic type equation with nonlocal integral boundary condition”

Authors: Prof. Misir J. Mardanov, phil. doctor in math Rafiq Teymurov

Optimal control of the motion of thermal sources in the systems described by different type equations (ordinary differential equation and parabolic type equation) was studied. The existence and uniqueness of such optimal control problems was proved, Frechet differentiability of the cost functional was given, expressions for the gradient respect to control parameters were obtained, necessary conditions for optimality in the form of pointed and maximum principle was obtained, solution algorithms for numerical solution of problems were structured.

1.2 One research work has been reflected in the following papers

1. М.Дж.Марданов, Р.А.Теймуров, Об одной задаче оптимального управления для параболического уравнения с нелокальными интегральными условиями, Доклады РАН, 2017, том.472, №2, с. 135-138. (I.F. 0.445) T. R. 23.

2. M.J.Mardanov, R.A.Teymurov, “Optimal control problem for a parabolic equation with nonlocal integral conditions”, The reports of national academy of sciences of Azerbaijan, Physical, Mathematical and Technical sciences, 2017, №1, p.20-24.

1.3 Work: “Elaboration of numerical methods of inverse of optimization problems for distributed parameter systems”.

Authors: Carr. mem. ANAS Kamil Ayda-zadeh

Synthesis of control effects in distributed parameter systems was studied on an example of boundary control and heating process of a bar. The inverse relation is performed by the measuring values of the state of the process at inner points and these values are used in formation of control. The statement of the synthesis problem was offered. Necessary formulas for solving the problem by means of first order numerical optimization methods were obtained.

1.3 One research work has been reflected in the following papers

1. К.Р.Айда-заде В.М.Абдуллаев. Оптимизация мест нагружения и функций реакции на нагружения для стационарных систем // Журнал вычислительной математики и математической физики, 2017, том 57, № 4, с. 633–644.

2. Ayda-zade K.R. Abdullaev V.M. Optimization of Control Points Location Under Synthesis of Heating Process Control // *Automatik and Remote Control*, 2017, Vol. 78, № 9, p.49-66.

3. Айда-заде К.Р.Абдуллаев В.М. Оптимизация размещения точек контроля при синтезе управления процессом нагрева // *Автоматика и телемеханика* 2017, том 57, № 4, с. 633–644.

4. К.Р.Айда-заде, Е.Р.Ашрафова Численное решение задачи определения мест и объемов утечек при неустановившемся движении жидкости в трубопроводной сети сложной структуры // *Журнал вычислительной математики и математической физики*, 2017, том 57, № 12, с. 36–52.

1.4 Work: Author: prof. Hamlet Guliyev

Reduction of inverse and ill-posed problems stated processes described by partial equations to control problems and studying them by the methods of theory of optimal control were considered.

1.4 One research work has been reflected in the following papers

1. Guliyev H.F., Seyfullayev Kh.I. On determination of the Right-Hand Side of the Linear Equation of Elastic Plate Vibrations // Journal of automation and information sciences, DOI: 10.1615/J. Automat Inf. Scien. v49.i4.70, Volume 49, 2017, Issue 4, p. 72-82.
2. Гулиев Г.Ф., Рамазанова А.Т. Об одной обратной задаче для уравнения изгибно-крутильных колебаний стержня // ATU, Scientific and technical magazine, 2017, №1, p.60-70.
3. Guliyev H.F., Seyfullayev Kh.I. Optimal Control problem for the equation of vibrations of an elastic plate // Georgian Mathematics Journal, 2017, p. 1-9.

1.5 Work: "Investigation of the extremal spectral problems with variable domain and fractional order differential equations"

Authors: Dr. Sc. Yusif Gasimov

The eigenvalue problems with variable domain and some their applications were considered. Eigen frequency of variable domain compressed plate was studied with respect to the functional of its domain, minimization of their functional with respect to the domain was researched, necessary conditions for optimal domain were formed and formulas for specific values of eigen frequency in some special cases, were derived. Furthermore, the wave solutions of Klein-Gordon and Helmholtz equations in the contour sets were studied and these solutions were found approximately.

1.5 One research work has been reflected in the following papers

1. Gasimov Y.S., Allahverdiyeva N.A. Shape optimization for the eigenfrequency of the plate, Georgian Mathematical Journal, 2017, DOI: 10.1515/gmj-2017-0005, 6p. IF-0.290.
2. Xiao-Jun Yang, Gasimov Y.S., Feng Gao, Allahverdiyeva N.A. Travelling-wave solutions for Klein-Gordon and Helmholtz equations on Cantor sets, Proceedings of the Institute of Mathematics and Mechanics, National Academy of Sciences of Azerbaijan, Vol. 43, No.1, 2017, pp.123-131. .-TR ESCI
3. Г.Ф.Гулиев, Ю.С.Гасимов, Х.Т.Тагиев, Т.М.Гусейнова, Об обратной задаче нахождения правой части волнового уравнения с нелокальным условием, Вестник Томского Государственного Университета, DOI 10.17223/19988621/49/2.-Scopus, 2017 TR ESCI. p.16-26
4. M.Z.Gashti, Y.S.Gasimov, G.Farjammia, S. M. Hashemi New Study the Required Conditions for using in Compression WSNs During the Data Collection, Int. J. Mechantronics, Electrical and Computer Technology, DOI: IJMEC/10.225160, 2017.
5. Qasimov Y.S., Allahverdiyeva N.A., About the convex dependence of the eigen frequency of the plate on its domain, International Scientific Conference "Theoretical

and applied problems of mathematics” dedicated to the 55th anniversary of Sumgait State University.

6. Gasimov Y.S., Aliyeva A.R. On a numerical solution of a shape optimization problem for the eigenvalues of Pauli operator, International Scientific Conference “Theoretical and applied problems of mathematics” dedicated to the 55th anniversary of Sumgait State University, 25-26 may 2017, p. 34-35.

II Development of analytic-information system based on Soft Commuting technology supporting planning, synthesis and execution of decisions under uncertainty conditions.

2.1 Work: “Development of neural-fuzzy methods and algorithms to support the optimal decision making process in organizational structures, including the management of educational institutions”

Authors: Doctor Science, professor Misir Mardanov, Doctor Science Ramin Rzayev

The carried out researches were connected with development of decision making process under uncertainty conditions, the methods for solving the complex of associated problems and algorithms. For example, models based on fuzzy logic for assessing competition aspects in higher school in labour market and marketing space of education services. Fuzzy approach was offered for working out flexible and universal system for assessing the rating of higher school institutions within the existing studies.

2.1 One research work has been reflected in the following papers

MONOGRAPH

Mardanov M.C., Rzayev R.R., Camalov Z.R. Нечёткая методология многокритериального ранжирования // Saarbruchen(Germany): Palmerium Academic Publishing, 2017, 164 p.

ABSTRACTS

1. Mardanov M.C., Rzayev R.R., Camalov Z.R., Hudadova A.K. Integrated assessment and ranking of universities by fuzzy inference // 9th International Conference on Theory and Application of Soft Computing, Computing with Words and Perception, ICSCCW 2017, 24-25 August 2017, Budapest, Hungary, p.8.

2. М.Дж. Марданов, Р.Р.Рзаев, «Два подхода к комплексной оценке и ранжированию вузов», Проблемы управления и информатики, №4, 2017, с.36-55.

3. М.Дж. Марданов, Р.Р.Рзаев. Комплексная оценка и ранжирование вузов методом нечёткого логического вывода // Материалы Международной научно-технической конференции «Автоматизация и приборостроение: проблемы,

решения» (АППР – 2017) при поддержке Российского Фонда фундаментальных исследований, Севастополь, РФ, 11 – 15 сентября 2017 г., стр. 13-14.

4. Mardanov M.C., Rzayev R.R., Camalov Z.R., Hudadova A.K. Integrated Assessment and Ranking of Universities by Fuzzy Inference. *Procedia Computer Science* (Scopus), 2017 (Submission is accepted)

III *History and methodology of mathematics*

3.1 İŞ: « History mathematics »

İcraçılar: f.-r.e.d., prof. Misir Mərdanov, f.-r.e.d., prof. Ramiz Aslanov

Scientific heritage of N.Toussi, K.F Gauss, J.L D’Alambert, Z.I. Khalilov was researched and the manuscripts that have not been studied before, were considered. For example, Agali Gasimov’s book “Scientific calculus”, Haji Samed bey’s book “Head Algebra” part I, Baku 1919. The second issue of Z.I. Khalilov’s book “Foundations of functional analysis” is prepared for publication in Moscow. The book will be published in Moscow in “URSS” publishing house. In future, the studies on predecessors of modern mathematics will be continued.

3.1 One research work has been reflected in the following papers

BOOKS

1. Misir Mardanov, “My teacher Goshgar Ahmedov” Baku, Radius, 2017, 264 page.

2. Асланов Р.М. «Высшая математика» (задачник), книга из пяти частей, часть 5.1, Москва, ООО «Прондо» 2017, 328 стр.. (соавторы: А.И. Нижников, А.А. Муханова, С.А. Муханов, Т.Р. Мурадов)

ABSTRACTS

1. М.Дж. Марданов, Р.М. Асланов, «Роль Насреддина Туси в развитии математического образования», И.И.Лобачевский и математическое образование в России: материалы Международного форума по математическому образованию, 18-22 октябрь 2017 г. Казан. ун-та, 2017. – Т. 1. . Стр 21-28.

2. М.Дж. Марданов, Р.М. Асланов «Научное наследие Карла Фридриха Гаусса в развитии современной математики (к 240-летию со дня рождения)» «Математика. Образование. Культура» (к 240-летию со дня рождения Карла Фридриха Гаусса), 26-29 апреля 2017 года, Россия, г. Тольятти / Изд-во ТГУ, 2017.- стр.6-15.

3. М.Дж.Марданов, Р.М. Асланов, «Математическое образование конца XIX-начала XX века в Азербайджане», Материалы Международной научно-практической конференции, г. Минск, 10-13 мая 2017 г., стр. 5-7.

4. М.Дж.Марданов, Р.М.Асланов, Т.Х.Гасанова Из истории развития математики в Азербайджане // Материалы Международной научной конференции «Теоретические и прикладные проблемы математики», 25-26 мая 2017 год, Сумгаит 2017, Азербайджан, стр. 8-12.

5. М.Дж. Марданов, Р.М. Асланов, О книге «Предшественники современной математики Азербайджана»// Вестник Елецкого государственного университета им И.А. Бунина.- Вып. 38: Елец: ЕГУ им. И.А. Бунина, 2017. стр. 10-14.

6. М.Дж. Марданов, Р.М. Асланов, Роль Жан Лерон Даламбера в развитии современной математики и механики (к 300-летию со дня рождения) / Математическое моделирование в экономике, управлении и образовании: сборник научных статей по материалам III Международной научно-практической конференции, 16-17 ноября 2017 г, с.190-198, Калуга.

7. М.Дж. Марданов, Р.М. Асланов, Т.Х.Гасанова «Научное наследие Кошкура Теймур оглы Ахмедова в развитии современной математики Азербайджана» (к 100-летию со дня рождения) // Continuum. Математика. Информатика. Образование. Выпуск №2(6) / Елец, 2017. стр. 85-97.

3.2 WORK: “Some problems from history of mathematics”.

Author: doct. ph.m.s prof. Ramiz Aslanov.

3.2 One research work has been reflected in the following papers

1. Асланов Р.М. О книге «Задачник по арифметике» композитора Узеира Гаджибекова, - материалы II Международной научно-практической конференции «Задачи в обучении математике, физике и информатике: теория, опыт, инновации» посвящённой 125-летию П.А. Ларичева, 2017.- стр. 37-43

2. Асланов Р.М., О.Г. Игнатова. Электронное обучение и его роль в преподавании математических дисциплин в педагогическом ВУЗе. Сборник статей участников Международной научно-практической конференции (25-27 мая 2017 г.) Арзамас: Арзамаский филиал ННГУ, стр.361- 364.

3. Асланов Р.М. Азербайджан в контексте мировой математики// «Международные Колмогоровские чтения- XIV», Коряжма: 2017г. 247с. стр. 139-147.

4. Асланов Р.М., Гасанова Т.Х. Нравственные взгляды в трудах Насираддина Туси Материалы III Международной научно-практической конференции «Математическое моделирование в экономике, управлении и образовании», 16-17 ноября 2017 г, стр. 105-115, Калуга.

5. Асланов Р.М., О магистратуре // International Conference “Modern problems of Mathematics and Mechanics” dedicated to the 80th jubilee of Akif Hajiyev. 6-8 december, 2017.

PARTICIPATION AT SCIENTIFIC SEMINARS

All collaborates have participated at the department seminars. Every thusday the seminar “Urgent problems of theory of optimal control” is conducted.

1. 19.01.2017 - Leading research associate of the Institute of Control systems, doctor in math. Sciences Vagif Maarif oglu Abdullayev. Numerical solution to a problem of feedback control for the rod heating process.
2. 09.02.2017- Dissertant of the Institute of Control systems Vugar Adam oglu Hashimov. The study of the problem of synthesis of border control of the heating process.
3. 02.03.2017- Dissertant of the Institute of Control systems Vugar Adam oglu Hashimov. Optimization and control of placements of point dampers on the plate.
4. 09.03.2017- The chief scientist of the Institute of Control Systems of National Academy of Science Ramin Rza oglu Rzayev. Fuzzy logic in the historical aspect: basic concepts and foundations.
5. 09.03.2017- The chief scientist of the Institute of Control Systems of National Academy of Science Ramin Rza oglu Rzayev. Fuzzy logic in the historical aspect: basic concepts and foundations.
6. 30.03.2017- The acting head of the laboratory of Mathematical problems of control of the Institute of Control Systems doctor of science in mathematics Ilgar Gurbat oglu Mammadov. Local and non-local boundary value problems combined in non-classic treatment for 3D and 4D Bianchi equations and their application to optimal control problems.
7. 13.04.2017- The acting head of the laboratory of Mathematical problems of control of the Institute of Control Systems doctor of science in mathematics Ilgar Gurbat oglu Mammadov. Local and non-local boundary value problems combined in non-classic treatment for 3D and 4D Bianchi equations and their application to optimal control problems.
8. 20.04.2017- Leading research associate of the Institute of Control systems, Ph.D. in math. Sciences Yegana Ramiz Ashrafova. The development and applications of numerical methods of solution to control and boundary-value problems by evolution systems with non-accurate given initial conditions.
9. 04.05.2017- The acting Candidate of Physical and Mathematical Sciences, Associate professor Shakir Yusubov. On two different statements of Dirichlet problem.
- 10.18.05.2017- Leading Research associate of the department and phys. math. sci. ass. prof. Mammadov Eldar Shamil oglu. Application of Simplex method for linear programming problems.
- 11.01.06.2017 - Professor of Baku State University, doctor of phys. math. sci. Misreddin Allahverdi oglu Sadigov. First and second order subdifferential.
- 12.28.09.2017 - Professor of Baku State University, doctor of phys. math. sci. Misreddin Allahverdi oglu Sadigov. Second order subdifferential.

- 13.12.10.2017 - Leading scientist of The Institute of Control Systems of ANAS, Dr., Assoc. Prof. Anar Rahimov. An approach to numerical solution to inverse source problems for a parabolic equation
- 14.17.10.2017 - senior research associate of Institute of Mathematics and Mechanics, doctor of physic. math. sci., prof. Telman Melikov. Weierstrass variant and Weierstrass condition for simple variation problem.

On scientific activity of doctoral students and candidates for a degree of the department

Candidate for a degree Samin Malik Telman oğlu, supervisor prof. M.Mardanov

1. Samin T. Malik, “The transformation of variation method for studying singular controls in dynamical systems with a delay in control. Materials of “Theoretical and Practical Problems of Mathematics” International Scientific Conference, Sumqayit 2017, p. 201.
2. Samin T. Malik, “The Maximum Principle of Pontryagin type for Discrete Systems with Delay in Control”, Materials of Scientific Conference “Actual problems of Mathematics and Mechanics” dedicated to the 100th jubilee of Goshgar Ahmedov, p.94, 2017.

Doctorant Samira Shaqavatova, supervisor prof. M.Mardanov

М.Дж. Марданов, Т.К. Меликов, С. С. Шагаватова, «Линеаризованные условия оптимальности в дискретных системах с запаздыванием в управлении», Materials of “Theoretical and Practical Problems of Mathematics” International Scientific Conference, Sumqayit 2017, p. 235.

Organizational activity

Head of the department prof. M.J.Mardanov is the chairman of the dissertation Council D.01.111 and of Scientific Council of the Institute. He is a member of editorial staff of “Translactions of ANAS”, “Azərbaycan Riyaziyyat Jurnalı”, “Чебышевский сборник” və “TWMS Journal of Applied Mathematics” (Turkic World Mathematical Society) is the editor in chief of “Proceeding of IMM, ANAS” journal.

Professor Telman Malikov is a member of math and mech expert council of AAK.

R. M. Aslanov is a member of editorial bound of “Vestnik Syktyvkavskogo Universiteta” Ser. 1. journal.

Institution signed contracts with Vologda State University and Northern (Arctic) Federal University in 2017.

The leading research associate of the department Yusif Gasymov is the editor-in-chief of the international journal “Advanced Mathematical Models and Applications”, a member of editorial board of “Journal of Modern Technology and Engineering”, of the journal “Applied Mathematics and Information Sciences”, of “TWMS Journal of Pure and Applied Mathematics”, a member of the Organizing Committee of the VI Confren of Mathematical Society of Turkic World.

Head of department:

prof.Misir Mardanov