Institute for Information Transmission Problems

LABORATORY 5

Laboratory of Teletraffic Theory

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The leading researchers of the laboratory include:

Dr.Sc. (Techn.)	A. Kharkevich	Dr.Sc. (Techn.)	V. Ershov
Dr.Sc. (Techn.)	S. Stepanov	Dr.	V. Naumov

DIRECTIONS OF ACTIVITY

The laboratory deals with the development of teletraffic theory and its applications in telecommunications and computer systems. The following problem areas and models are studied at the laboratory in 2004:

- the construction of numerically optimized algorithms of calculation the performance measures of queuing models described by multi-dimensional random processes;
- the development and analysis of teletraffic models in performance evaluation of new cost-effective telecommunication systems;
- the development of the software tools based on the efficient algorithms to support the performance modeling of the teletraffic models;
- the construction of the asymptotically optimal procedures for the sequential design of experiments in statistical problems related to telecommunication networks;
- the analysis of switching systems and interconnection networks of telecommunication and multiprocessing systems.

MAIN RESULTS

An approach that can be used for constructing numerically stable versions of recursive algorithms for estimation of performance measures of multi-rate models that appear in description of common sharing of bandwidth by a number of connections is derived. The approach is a generalisation to multi-rate models of the well-known recurrence Erlang's formula. At each step of recurrence we deal with normalised values of state probabilities used for estimation of main stationary performance measures. This makes it very well suited for solving problems of dimensioning. In addition to being numerically stable, the main positive features of the suggested approach are its simplicity and small storage and computational requirements. (S.N. Stepanov, E.O. Naumova, E.I. Melik-Gaikazova)

A simulation method for small probability events generated by a self-similar diffusion processes mixture was constructed. It gives a possibility of overflow probability of a buffer in multiservice network with a small probability of an overload failure. It was found that a multiservice network traffic model based on self-similar diffusion processes with fixed Herst parameter is not robust one in a prescribed QoS network modeling. (I.I. Tsitovich)

The program package using to solve problems with a digit capacity increased up to 30-45 digits and more has been developed. The problems connected with a computation of algebraic equations and modular polynomials present the special com-

plexity. To increase an accuracy of calculation every rational number is represented by an following assembly: integer number will be a sign of the rational number; integer number will be an order of it; certain selected integer number *N* of rational numbers, that have an usual dilated accuracy (16 decades), will be the number of groups of digits (15 decades in each group) in that rational number. The last number uses only 15 digits from 16. The sign has two possible values: +1, and -1. The number of digit groups *N* may be 1, 2, 3 and so on. The arithmetic algorithms at such high accuracy of calculation have been developed. They may execute four fundamental operations of arithmetic and an operation of founding a root of such multi-digit numbers.

Analysis and development of the estimation methods for terminal traffic have been considered. (A.D. Kharkevich, A.A. Vitkova)

A mathematical model for a 3-nodes multiservice network with direct routes to transmit different dispersive parameters traffic flows generated by different classes users was developed and investigated. On the basis of the model algorithm and MathCad language program in Windows environment were developed to evaluate the throughput characteristics. The 3-nodes network with not Poissonian streams of traffic was investigated. It was shown that the convergence of iteration process was achieved with 2-3 iterations accurate to 0.01% independently of initial data values for this model. (V.A. Ershov, O.F. Sergeeva)

It is described a diagnostic algorithm for interconnecion networks, which can detect and localize defective switching elements. For that purpose a number of exact cuts and elementary chains is being constructed which cover the interconnection network. (V.A. Garmash)

The queuing networks with input flows of Markov type and general distribution of service times at nodes of the network with parameters of the flows and of the service depending on their states were investigated. The analytical methods for calculation of the stationary characteristics of different queuing networks with single-class customers were obtained. The necessary and sufficient conditions of their analytic form expression existing were obtained. The possibility of a dependence of customer's circulation between the nodes of the network on its states was investigated. (O.V. Ivnitskii)

WORK WITH YOUNG SCIENTISTS

Members of the laboratory were lecturers in MFTI(TY), MTUCI, MIREA(TY), MSURE(MIIT), they were scientific advisers of 24 degree theses and 9 post-graduate students. V. Ershov was a lecturer in Giprosvjaz.

PUBLICATIONS IN 2004

Articles

1. Ивницкий В.А., Ивницкий О.В. О нестационарном распределении времени ожидания в системе обслуживания M/G/1 с ограниченным буфером и дисциплиной случайного выбора. *Обозрение прикладной и промышленной математики*, 2004, т. 11, № 4 (in print).

2. Astakhova T.N., Petrova E.V., Tsitovich I.I., Roytberg M.A. Recognition of coding regions in genome alignment. *Proc. 4th International Conference on Bioinformatics of Genome Regulation and Structure*. Novosibirsk: IC&G, 2004, vol.1, pp. 30-33.

3. Iversen V.B., Benetis V., Ha N.T., Stepanov S. Evaluation of Multi-service CDMA Networks with Soft Blocking. *Proc. 16th ITC Specialist Seminar on Performance Evaluation of Wireless and Mobile Systems. University of Antwerp*. Antwerp.

Belgium, 2004, pp. 111-120.
4. Iversen V.B., Stepanov S.N., Kostrov V.O. The Derivation of a Stable Recursion for Multi-Service Models. *Proc. of International Conference on Next Generation Teletraffic and Wired/Wireless Advanced Networking, NEW2AN.* St. Petersburg, 2004, pp. 254-259.
5. Stepanov S.N., Iversen V.B., Kostrov V.O. Modelling issues of integrating services in Next Generation Networks. *Proc. of ITU-ITC regional seminar on network evolution to next generation networks and fixed mobile convergence for CEE, CIS and Baltic states*. Moscow, 2004, pp. 375-395.
6. Vitkov M.G., Vitkova A.A. Synthesis of Continuous-Signal and Digital Filters. *Information Processes (Эл. научный журнал. Эл. N 77-4172 от 27 октября 2000 г.).* ИПМ РАН и ИППИ РАН, 2004, т.4, № 1, стр. 76-116.

Theses

1. Бубнов Ю.А., Цитович И.И. О вычислении несобственного интеграла от медленно убывающей функции. *Труды 59–ой Научной сессии Российского научно-технического общества радиотехники, электроники и связи им. А.С.Попова, посвященной Дню радио*. Москва, 2004, т. 2, стр. 179.
2. Витков М.Г., Виткова А.А. Синтез цифровых КИХ фильтров. *Материалы науч. конф. МТУСИ*. М.: МТУСИ, 2004, кн. 1, стр. 207-208.
3. Ивницкий В.А., Ивницкий О.В. Кусочно-линейная сеть массового обслуживания с разными классами требований и дисциплиной "обобщенное разделение процессора". *Обозрение прикладной и промышленной математики*, 2004, т. 11. № 2, стр. 344-346.
4. Кокина О.А, Степанов С.Н. Математическая модель фрагмента мультисервисной сети связи с учетом поведения абонента. *Труды 59–ой Научной сессии Российского научно-технического общества радиотехники, электроники и связи им. А.С.Попова, посвященной Дню радио*. Москва, 2004, т. 2, стр. 179-181.
5. Порязов С.А., Харкевич А.Д. Модель систем связи с коммутацией каналов, гетерогенными терминалами и всеми основными видами потерь. *Труды 59–ой Научной сессии Российского научно-технического общества радиотехники, электроники и связи им. А.С.Попова, посвященной Дню радио*. Москва, 2004, т. 2, стр. 189-191.
6. Степанов С.Н., Костров А.В. Частные производные индивидуальных блокировок по значениям интенсивности информационных потоков на звене мультисервисной сети связи. *Труды 59–ой Научной сессии Российского научно-технического общества радиотехники, электроники и связи им. А.С.Попова, посвященной Дню радио*. Москва, 2004, т. 2, стр. 183-184.
7. Степанов С.Н., Хромов А.Ю. Модели теории телетрафика, используемые для оценки характеристик пропускной способности сетей подвижной связи, выполненных на основе технологии CDMA. *Труды 59–ой Научной сессии Российского научно-технического общества радиотехники, электроники и связи им. А.С.Попова, посвященной Дню радио*. Москва, 2004, т. 2, стр. 184-185.