Research topics Akimine Nishikori

1. Study on constrained load (power) flow of electric power systems, and on the development of its large-scale software
2. Suggestion on information network and software center of Japan
3. Study on display expression of sparse data structure for a large-scale spread sheet
4. Study on data structure for large-scale constraint satisfaction
5. Development of an approximation method using search trees and its large-scale software for solving large-scale constraint satisfaction and assignment problems with priority order
6. Study on competitive voting and budget distributing algorithm for selecting the 21st century COE programs
7. Study on repeated bids for many articles by combinatorial auction
8. Study on subjective distances in trade area model around the new Hiroshima baseball stadium
9. Study on logistics and facility location for cities in Chugoku and Shikoku regions
10. Study on the necessary and sufficient condition on subtour elimination constraints in the formulation of symmetric traveling salesman problem
11. Study on developing the software using the incremental method by constant time for solving (modified) job shop scheduling problems
12. Study on algorithmic expression of neural network optimization using augmented Lagrangean function
13. 14. Application for simple patents on IT and structures

Outline of Research Akimine Nishikori

The study 3), 4) and 5) presents sparse and large-scale data structure for management software system on mathematical planning. A lot of studies previously researched are discussed from the various points of view, which mean information systems, software engineering, artificial intelligence and knowledge information systems.

This study proposes three kinds of sparse data structures, that is, a matrix with rows and columns, the spread sheets and search trees.

・The first structure is used for the constrained load (power) flow of practical electric power systems. This is an optimization problem which obtains a feasible solution with considering priority orders. The problem becomes large-scale in applying to real cases.

・The second exploits display expression of too large-scale spread sheet with sparse data structure to show the whole sheet on a single screen. The display expression of a computer only shows cells with data after automatically dropping other cells of no data.

・The third is for desirable constraint satisfaction in the field of artificial intelligence. The constraint satisfaction means large-scale assignment problems with priority orders. The solution technique is to search state space by using several search trees.

All of the three data structures treat sparse and large-scale in search and/or its data stored.

1. Study on constrained load (power) flow of electric power systems, and on the development of its large-scale software

This paper presents an efficient algorithm for solving the following constrained load flow (CLF) problem: In case that voltages or reactive powers of generators violate their upper or lower limits, the violations are corrected by the method of adjusting the control variables, such as generator voltages, load reactive powers and transformer tap ratios. That is to say, in the proposed algorithm, specified values of voltage magnitudes, reactive powers and transformer taps are adjusted one by one within their upper and lower limits for satisfying the upper and lower limit constraints of unspecified values of voltage magnitudes and reactive powers. Also, specified values are adjusted one by one according to predetermined priority order.

This is an optimization problem which obtains a feasible solution with considering priority order. The problem becomes large-scale in applying to real cases. In the proposed algorithm, the modified program of load flow (LF) is successively used. Since the sum of squared limit-violations is monotonically decreased, the CLF solution can always be obtained by the proposed algorithm.

2. Suggestion on information network and software center of Japan

This paper presents double duplicate information system. In particular, the proposed system is necessary for each bank company with many ATM machines. The double duplicate information system means both dual and by-polar computer systems. The dual computer system has double systems, each of which has the same ability and capacity. If one computer system shuts down by maintenance or contingency, then the other system works instead of the stopping system. Moreover the by-polar system has two of the dual systems. The two is far away from each other. For instance, the two remote and large cities are Tokyo and Osaka in Japan. Although one dual system happens to be destroyed by large earthquake and becomes out of operation, the other dual system is alive and continue to work usually. Therefore, the paper proposes that one bank company should have the facilities of the dual system in each of the two cities. Such a double duplicate system needs four times of the hard disk memory in comparison with a single computer system. A lot of demand results from the breakthrough of HDD cost and performance.

The transaction of the paper was the memorial that opens the door of the 21st century. That is, the double duplicate system was proposed in the first month of the first year of the 21st century.

3. Study on display expression of sparse data structure for a large-scale spread sheet

This paper proposes display expression of a computer, by which it is easy to see a large-scale spread sheet with sparse data structure. If a spread sheet is a sparse matrix and too large, it is impossible to show the whole sheet on one screen. In such a case, a screen is changed to another to see necessary part of the sheet. The data structure of the proposed visual expression exploits duplicate packed sequential allocations, each of which sorts nonzero numerical data row by row or column by column. The display expression only shows cells with nonzero data after automatically dropping other cells.

4. Study on data structure for large-scale constraint satisfaction

This paper presents an approximation method for solving a large-scale assignment problem, which is one of constraint satisfaction (CS) problems in the field of artificial intelligence. In the proposed method, for obtaining a desirable solution among many integer feasible solutions, priority orders of resources are predetermined, and CS problems are repeatedly solved to decrease the sum of infeasibilities of constraints. Furthermore, in searching state space by using many search trees, the method exploits double garbage collections to avoid fragmentation of memory space not used. Although assignment problems become large-scale in applying to real cases, the method can solve an assignment problem with about one hundred thousands integer variables.

5. Development of an approximation method using search trees and its large-scale software for solving large-scale constraint satisfaction and assignment problems with priority order

This paper presents an approximation method for obtaining a feasible solution of a large-scale assignment problem with priority order. In the method, a set of integer variables to be changed is chosen by means of search trees, and then the integer variables are changed. Both maximum priority order and the number of resources with the maximum order become as small as possible. No efficient method has not been developed yet for solving the considered assignment problem. The proposed method is applicable to assignment problems whose cost coefficients cannot clearly be determined.

6. Study on competitive voting and budget distributing algorithm for selecting the 21st century COE programs

Twenty-first century COE (center of excellence) committee officially announces judging requirements for selecting (thirty) excellent research fund programs. Such a selection algorithm is a voting system. This paper proposes a voting algorithm for electing research fund programs, e.g., thirty programs of 21st century COE. The proposed algorithm distributes the total budget of fund programs after electing fund programs. In this developed algorithm, competitive a) voting and b) distributing are as below.

a) After many members in the committee are elected from various fields, programs are evaluated by the elected members from different viewpoints. That is, fund programs are voted and decided by majority. Moreover, programs near to the border line which is decided by the number of obtained votes are again voted. By the second voting the rankings of the programs are rearranged, and thus the fund programs obtaining more votes are elected and determined.

b) Total budget is distributed among the elected fund programs, each of which suggests a special research project plan, as follows: First, the total budget is divided among all the members, and then the divided budget of each member is moreover distributed among the elected programs. This procedure is carried out by tendering points instead of money. Thus the total money given to each elected program is determined by the sum of points tendered by all the members.

7. Study on repeated bids for many articles by combinatorial auction

This paper considers repeated bids for many articles by combinatorial auctions. By the internet, many people who are remote each other participate in the auctions. The auctions in this paper manage a listing site in which many buyers and sellers repeatedly bid for combinatorial articles. In the auction, if several buyings and sellings are possible for only one article, the buying and selling of the greatest money is chosen. Buyings and sellings which become maximum amount of money are determined by the mathematical optimization software XPRESS-MP/Mosel. This optimization is formulated as maximizing the total amount of buyings money subject to two types of constraints. One type of constraints is for each article and the other is for each buyer.

8. Study on subjective distances in trade area model around the new Hiroshima baseball stadium

This paper studies subjective distances in trade area model around the new Hiroshima baseball stadium. Ten towns, each of which has the population of more than two thousands, are selected, and the tenth town means the new stadium of the people gathering to watch the baseball game. Each town has two routes from the town to the two groups of retail stores in Hiroshima station area and in Hiroshima Fuchu Soleil. This study considers data of necessary times needed to come through the routes, cycle times of traffic signals and the population of towns around the new stadium. Using the various data, numerical simulation on subjective factors by traffic signals is carried out. By the simulation, necessary times needed to come to the two trade areas are calculated, and the probability and number of people coming to each retail store are estimated. Moreover, necessary times are changed where coming to Hiroshima station by bicycle and to Hiroshima Fuchu Soleil by car. For all the routes, traffic signals are adjusted, and hence the necessary times needed are reduced by five seconds.

9. Study on logistics and facility location for cities in Chugoku and Shikoku regions

This paper presents a mathematical formulation of a transportation planning and facility location problem for 52 cities in five prefectures of the Chugoku region. The formulation determines locations, i.e., cities in which facilities are located, and the facility capacity of each city is decided from three levels. Also the formulation considers an upper bound for the number of cities located. This is a mixed 0–1 integer programming problem with 156 integer and 2,704 real variables and 52 equality and 105 inequality constraints. In 2,704 real variables, the values of 974 variables remain fixed and the others are nonnegative. In numerical simulation, exact and approximate optimal solutions are obtained by mathematical programming software XPRESS-MP.

This paper presents a mathematical formulation of a transportation planning and facility location problem for 34 cities in four prefectures of the Shikoku region. The formulation determines locations, i.e., cities in which facilities are located, and the facility capacity of each city is chosen from three levels, i.e., large, middle or small. Also the formulation considers an upper bound for the number of cities located. Using demands of 34 cities and practical moving distances by express and general ways, numerical simulation is carried out. Each demand is decided in proportion to the population of the city. This is a mixed 0–1 integer programming problem with 102 integer and 1156 real variables and 34 equality and 69 inequality constraints. Among 1156 real variables, the values of 266 variables remain fixed and the others are nonnegative. The results by the numerical simulation show both facility locations and transport amounts moving from the locations. The map on facility locations illustrates distribution centers, and utility rations of their capacities are obtained. In numerical simulation, exact optimal solutions are obtained by mathematical programming software Fico Xpress in Fujitsu personal computer (Intel Core2Duo, 2.93GHz). The computing times of two examples are within about ten seconds.

10. Study on the necessary and sufficient condition on subtour elimination constraints in the formulation of symmetric traveling salesman problem

The traveling salesman problem (TSP) is one of combinatorial optimization problems. The purpose of the TSP is to minimize the traveling distance in a tour, and the objective of the tour is to go round through all cities (namely, nodes). The total number of nodes in the TSP is denoted as an integer number n, and the distance between node i and node j is denoted as d_{ij} (>0). If it is assumed that $d_{ij} = d_{ji}$ for any i and any j, then the problem is called the symmetric TSP. The software of mathematical programming system (MPS) is capable of solving the TSP formulated as an integer programming problem.

The symmetric TSP is formulated as an integer programming problem which has linear equalities and inequalities. In the formulation, integer n is the total number of nodes, and integer variable X_{ij} ($i,j=1,2,...,n$; $i>j$) is defined by $X_{ij}=1$ (if arc (i,j) is in the tour) or $X_{ij}=0$ (otherwise). The linear equalities mean that each node has two arcs, and the linear inequalities are called "subtour elimination constraints."

The formulation is not obvious in expressing the linear constraints of the symmetric TSP. That is to say, the subtour elimination constraints are not strictly expressed in the mathematical formulation. In the published reference, the number of nodes related to each subtour elimination constraints was denoted as ($n/2$) at most, and no explanation, proof or reference on the necessary and sufficient number was shown. Also in the same year, the references were published in which the author of this paper, namely, I exactly proved the condition on subtour elimination constraints.

On the symmetric TSP, this paper states the formulation in which the objective function and constraints are linear. This paper proves that all the subtours in the symmetric TSP can be excluded by excluding the subtours, each of which contains ($n/2$) nodes or contains less than ($n/2$) nodes. In case of an even number n, also proves that excluding all the subtours, each containing ($n/2$) nodes, is corresponding to the half of all the constraints for eliminating the subtours, each containing ($n/2$) nodes.

In case of the symmetric TSP, the number of necessary and sufficient constraints for eliminating all the subtours is expressed by the function of n (i.e., total number of nodes) in the formulation of this paper. By this expression, the integer programming problem can be represented for any integer number n.

From the proof in this paper, the necessary and sufficient constraints for eliminating all the subtours can be determined and obviously represented. Therefore, on the formulation, the author proves that it is impossible to decrease the number of constraints moreover.

11. Study on developing the software using the incremental method by constant time for solving (modified) job shop scheduling problems

Job shop scheduling in manufacturing systems is planned by a dispatching rule. In general, incremental time in a simulation method for job shop scheduling problems is not constant but variable. In an incremental method by constant time, every occurring event is processed according to clock time changed by unity. This paper presents an incremental method by constant time for solving job shop scheduling problems. Also the proposed method is applicable to the modified job shop scheduling problem in which preceding relations are altered, i.e., there are a few preceding processing operations although only one preceding processing operation generally exists.

12. Study on algorithmic expression of neural network optimization using augmented Lagrangean function

This paper presents a novel formulation of traveling salesman problem which is solved by Chaos neural network. The formulated problem exploits an augmented Lagrangean function instead of a simple penalty function. The Lagrangean function contains linear and squared terms of equality constraints, and coefficients of the linear terms are Lagrangean multipliers. By solving numerical examples, the proposed formulation has been compared with a usually used formulation with a penalty function.

13 14. Application for simple patents on IT and structures

The importance on a patent is not to write the document of the patent based on experiments. Noticing the idea on the patent is most valuable.

This paper presents practical instances on MOT (Management of Technology) finding ideas of industrial patents. The several instances are on the following structures : a) a violin, b) an engine, c) a rotary engine, d) weakening sea waves by embankment, e) wind blowing across a flying airplane, f) spraying solvent, and g) transmission lines of electricity.

Almost the instances are for spreading fluid, e.g., gas, liquid, and sound waves. Furthermore, this paper proposes multiple encryptions and encrypted redundant letters of an OS command.