Alexander Grigoriev

Associate Professor

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Summary

Research on complexity of and algorithms for combinatorial optimization problems.

Supervision of PhD and Master students specializing in Operations Research and (Discrete) Applied Mathematics.

Teaching courses in Operations Management, Operations Research, Algorithms and Optimization at Maastricht University for Business, Econometric and Operations Research students of bachelor and master programs.

Specialties

Computational complexity, approximation algorithms, algorithmic graph theory, combinatorial optimization, operations research, pricing, scheduling, computational geometry

Experience

Associate Professor at Maastricht University
January 2010 - Present (4 years 3 months)

Assistant Professor at Maastricht University
September 2005 - January 2010 (4 years 5 months)

Postdoc at Maastricht University
October 2003 - August 2005 (1 year 11 months)

In 2003-2005, as a postdoc, I joint the project “Treewidth and Combinatorial Optimization (TACO)” led by Hans Bodlaender (Utrecht University) and funded by the Netherlands Organisation for Scientific Research (NWO). There, I dealt with algorithm design for a variety of network optimization problems. I also obtained several results for geometric problems.

1 recommendation available upon request

PhD-student at Maastricht University
October 1999 - September 2003 (4 years)

High multiplicity scheduling problems are very common and very natural problems arising in modern mass production systems. The main aim of this PhD-project was to develop algorithms solving such problems. Project "High Multiplicity Scheduling Problems" was supervised by Prof. Dr. Ir. Antoon Kolen, Prof. Dr. Yves Crama, and Dr. Joris van de Klundert.

1 recommendation available upon request

Head of R&D at Zolotaya Korona

October 1996 - October 1999 (3 years 1 month)

(Smart Card) Payment System

Head of R&D at Sibirski Torgovy Bank
October 1994 - October 1996 (2 years 1 month)

R&D department for retail payment systems

Business Analyst at Sibirski Torgovy Bank
May 1994 - October 1994 (6 months)

Research Assistant at Sobolev Institute of Mathematics
January 1992 - May 1994 (2 years 5 months)

Honors and Awards

Excellent Undergraduate Educator Award 2013
Maastricht University School of Business and Economics
December 2013

Skills & Expertise

Operations Research
Combinatorial Optimization
Pricing
Scheduling
Computational Geometry
Research
Optimization
Algorithms
Teaching
Applied Mathematics
Graph Theory
Algorithm Design
Mathematical Modeling
Mathematics
Modeling
Planning
Business Intelligence
Science
Theory
Computer Science
Operations Management
Business Analysis
Linear Programming
Graph Algorithms

TOE
Optimizations
Discrete Mathematics
Statistics
Game Theory

Publications

Modelling and solving the periodic maintenance problem
European Journal of Operational Research 172, No. 3, pp. 783-797 August 2006
Authors: Alexander Grigoriev, Joris van de Klundert, Frits Spieksma

We study the problem of scheduling maintenance services. Given is a set of m machines and integral cost-coefficients a(i) and b(i) for each machine i (1<=i<=m). Time is discretized into unit-length periods; in each period at most one machine can be serviced at a given service cost b(i). The operating cost of machine i in a period equals a(i) times the number of periods since the last servicing of that machine i. The problem is to find a cyclic maintenance schedule of a given length T that minimizes total service and operating costs. We call this problem the periodic maintenance problem or PMP.
In this work we are interested in computing optimal solutions to instances of PMP. We investigate several formulations for PMP. Two formulations, referred to as a flow formulation and a set-partitioning formulation, appear to have good linear programming relaxations. We exploit the problem structure by showing how the column generation subproblem can be solved in polynomial time. Our work leads to the first exact solutions for larger sized problem instances, and we present extensive computational results.

Machine scheduling with resource dependent processing times
Mathematical Programming 110, No.1, pp. 209-228 June 2007
Authors: Alexander Grigoriev, Maxim Sviridenko, Marc Uetz

We consider machine scheduling on unrelated parallel machines with the objective to minimize the schedule makespan. We assume that, in addition to its machine dependence, the processing time of any job is dependent on the usage of a discrete renewable resource, e.g. workers. A given amount of that resource can be distributed over the jobs in process at any time, and the more of that resource is allocated to a job, the smaller is its processing time. This model generalizes the classical unrelated parallel machine scheduling problem by adding a time-resource tradeoff. It is also a natural variant of a generalized assignment problem studied previously by Shmoys and Tardos. On the basis of an integer linear programming formulation for a relaxation of the problem, we use LP rounding techniques to allocate resources to jobs, and to assign jobs to machines. Combined with Graham's list scheduling, we show how to derive a 4-approximation algorithm. We also show how to tune our approach to yield a 3.75-approximation algorithm. This is achieved by applying the same rounding technique to a slightly modified linear programming relaxation, and by using a more sophisticated scheduling algorithm that is inspired by the harmonic algorithm for bin packing. We finally derive inapproximability results for two special cases, and discuss tightness of the integer linear programming relaxations.

Treewidth Lower Bounds with Brambles
Algorithmica 51, No. 1, pp. 81-98 May 2008

Authors: Alexander Grigoriev, Hans Bodlaender, Arie Koster

In this paper we present a new technique for computing lower bounds for graph treewidth. Our technique is based on the fact that the treewidth of a graph G is the maximum order of a bramble of G minus one. We give two algorithms: one for general graphs, and one for planar graphs. The algorithm for planar graphs is shown to give a lower bound for both the treewidth and branchwidth that is at most a constant factor away from the optimum. For both algorithms, we report on extensive computational experiments that show that the algorithms often give excellent lower bounds, in particular when applied to (close to) planar graphs.

On the minimum corridor connection and other generalized geometric problems
Computational Geometry 42, No. 9, pp. 939-951 November 2009
Authors: Alexander Grigoriev, Hans Bodlaender, Corinne Feremans, , Rene Sitters, Thomas Wolle

In this paper we discuss the complexity and approximability of the minimum corridor connection problem where, given a rectilinear decomposition of a rectilinear polygon into “rooms”, one has to find the minimum length tree along the edges of the decomposition such that every room is incident to a vertex of the tree. We show that the problem is strongly NP-hard and give a subexponential time exact algorithm. For the special case when the room connectivity graph is k-outerplanar the algorithm running time becomes cubic. We develop a polynomial time approximation scheme for the case when all rooms are fat and have nearly the same size. When rooms are fat but are of varying size we give a polynomial time constant factor approximation algorithm.

The valve location problem in simple network topologies
INFORMS Journal on Computing 22, No. 3, pp. 433–442 August 2010
Authors: Alexander Grigoriev, Hans Bodlaender, Nadejda Grigorieva, Albert Hendriks

To control possible spills in liquid or gas transporting pipe systems, the systems are usually equipped with shutoff valves. In case of an accidental leak, these valves separate the system into a number of pieces, limiting the spill effect. In this paper, we consider the problem, for a given edge-weighted network representing a pipe system and for a given number of valves, of placing the valves in the network in such a way that the maximum possible spill, i.e., the maximum total weight of a piece, is minimized. We show that the problem is NP-hard even if restricted to any of the following settings: (i) series-parallel graphs, and hence graphs of treewidth two; and (ii) all edge weights equal one. If the network is a simple path, a cycle, or a tree, the problem can be solved in polynomial time. We also give a pseudopolynomial-time algorithm and a fully polynomial-time approximation scheme for networks of bounded treewidth.

Education

Maastricht University
Ph.D., Operations Research, 1999 - 2003
Activities and Societies: International Symposium on Mathematical Programming 2000, Workshop on Models and Algorithms for Planning and Scheduling Problems 2001, International Symposium on Algorithms and Computation 2002, Workshop on Models and Algorithms for Planning and Scheduling Problems 2003

Novosibirsk State University (NSU)
M.Sc., Pure & Applied Mathematics, 1992 - 1994

Activities and Societies: University Athletics Club

Novosibirsk State University (NSU)
B.Sc., Pure & Applied Mathematics, 1988 - 1992
Activities and Societies: University Athletics Club

Novosibirsk School for Physics and Mathematics
High school diploma, Mathematics, Physics, Chemistry, and Biology, 1986 - 1988

1 recommendation available upon request

Interests

Combinatorial Optimization, Algorithms, Operations Research, Algorithmic Graph Theory

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3 people have recommended Alexander

"Alexander Grigoriev was, many years, ago, Postdoc in the TACO-project (Treewidth and Combinatorial Optimization). Since then, Alexander and I worked together on several papers. In all cases, Alexander did excellent work, and proved to be reliable, but also technically very skilled. It was and is always very enjoyable to cooperate with him."

— Hans Bodlaender, *Associate professor (UHD), Utrecht University*, was with another company when working with Alexander at Maastricht University

"Having had the privilege to offer Alex his first job outside of Russia, I am most happy to write here about Alex. He was eager to be a productive researcher from the first to the last day of his Ph D, and successful at it. Moreover, he was (and is!) always good tempered, full of energy, and a very pleasant colleague."

— Joris van de Klundert, *Various Positions, Maastricht University*, managed Alexander at Maastricht University

"Alexander always was the heart of company, good sportsman and a talented organiser in a school Pupil's Committee and Summer School'88. Mathematics was his hobby and favourite subject. I'm glad he is loyal to his dream: the rare virtue and bounty."

— Maxim Drobyshev, *Student, Novosibirsk Physics-Mathematics School*, studied with Alexander at Novosibirsk School for Physics and Mathematics

Contact Alexander on LinkedIn