MADALGO
CENTER FOR MASSIVE DATA ALGORITHMICS

AARHUS UNIVERSITY

Danmarks Grundforskningsfond
Danish National Research Foundation

ANNUAL REPORT 2010

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2010 Highlights

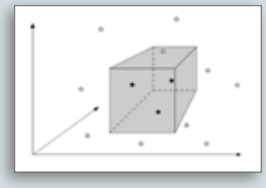
Research team

At the end of 2010 the center research team consisted of six senior researchers (2 at AU), five Postdocs (4 at AU) and eighteen PhD students (10 at AU). Additionally, three further Postdocs and two PhD students (one of which obtained PhD degree during the year) were part of the center in 2010. All center Postdocs are internationals and so are a good deal of the PhD students.

Research collaboration and results

In 2010 MADALGO researchers published 53 peer reviewed research paper within the center research areas. Several of these papers have appeared in highly ranked journals and conference proceedings. Some of the results in the papers have been obtained with the many international researchers that have visited MADALGO in 2010. The center also has extensive multi-disciplinary and industry collaboration.

Orthogonal range reporting is a very fundamental data structure problem. It consists of storing a set of *d*-dimensional points such that all points in an axis-parallel query box can be found efficiently (fast). Developing optimal orthogonal range reporting structures in higher dimensions than two is a classical and longstanding open research problem.



In 2010 MADALGO researchers developed optimal three-dimensional othogonal range reporting structures and proved for the first time that the query time has to increase with the number of dimensions.

Center events

Apart from a large number of smaller research seminars and workshops, as well as a retreat for center employees, MADALGO organized a four day international summer school on Geometric Data Structures in 2010, where four international experts lectured for around 50 participants (mostly PhD students) from 26 institutions in 14 nations.

The center also organized the Second Workshop on Massive Data Algorithmics (MASSIVE 2010), in connection with Symposium on Computational Geometry in Snowbird, USA. The goal is to eventually make the workshop a full-fledged annual conference co-located with one of the major broad algorithms conferences.

In 2010 center researchers also gave numerous presentations at international research conferences, as well as more than 35 invited presentations at research conferences, workshops and seminars.

Awards and acknowledgments

Center researchers received a number of awards and acknowledgments in 2010.

Center Director Arge received the prestigious Danish Minister of Research Elite Research Award ("Videnskabsministerens EliteForsk-Pris") and center senior research Mehlhorn the European Association of Theoretical Computer Science (EATCS) award. Senior researcher Indyk was appointed Associate Editor of the journal *IEEE Transactions on Signal Processing.*

Center PhD student Larsen received a Google European Doctoral Fellowship and center Postdoc Afshani a postdoctoral fellowship from the Natural Sciences and Engineering Research Council of Canada. Center PhD student Nelson received the best paper award at the 2010 *Symposium on Principles of Database Systems.*

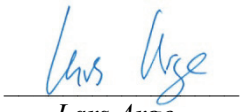
Content

This report describes the 2010 activities at the Danish National Research Foundation's *Center for Massive Data Algorithmics* (MADALGO). The report is accompanied by a number of appendices (covering external relations, conferences, educational activities, external funding, awards, public outreach, patents and applications, publications, list of personnel) as specified by the foundation. The appendices are an important part of the annual report (and information such as external funding and teaching is only covered in the appendices). Note that *some* of the appendices only cover the employees at Aarhus University (and not the participants at Max Planck Institute for Informatics, Massachusetts Institute of Technology and Frankfurt University). Finally, note that the 2010 accounts for the center with appendices (as well as the original center research plan and previous yearly reports) are also important in order to obtain a complete overview of the 2010 activities of the center.

Center director statement

By signing I confirm that this annual report and the accounts therein, including notes and summaries, contain all relevant information relating to this year's main activities in the Danish National Research Foundation's Center for Massive Data Algorithmics.

March 31, 2011



Lars Arge
Center Director

1 Center background and organization

Center for Massive Data Algorithmics (MADALGO) strives to be a world-leading center in algorithms for handling massive data, where massive is interpreted broadly to cover computations where the data is large compared to the resources of the computational device. The center particularly focuses on designing algorithms in theoretical models that take the hierarchical memory organization of modern machines into account. The center builds on the research strength at the main center site at Aarhus University (AU) in Denmark (with Brodal and Arge as senior faculty), at the center sites at the Max Planck Institute for Informatics (MPI) and at Frankfurt University (FRA) in Germany (with Mehlhorn and Meyer as senior faculty), and at Massachusetts Institute of Technology (MIT) in the US (with Demaine and Indyk as senior faculty). The center also relies on significant international research collaboration, multidisciplinary and industry collaboration, and tries to maintain a vibrant international environment at the main center site.

Organizationally the center has been quite stable during 2010. Scientifically the center continues to be lead by center director Lars Arge along with the other core faculty and with advice from the centers international advisory board. Logistically the main center site continues to be managed by center manager Else Magård and accountant Ellen Lindstrøm (half time), with secretarial support from the Department of Computer Science. A programmer has also been associated with the center in 2010. On the research personnel side, the center Post Doc and PhD student population has developed more or less as anticipated. The center had anticipated hiring an Associate Professor at AU in 2010, and AU did in fact extend an offer to Norbert Zeh, which the center had actively been recruiting for example during his 2009-2010 sabbatical stay at the center. However, for family reasons he chose to stay in Canada. The center continues its efforts to recruit a senior faculty member that is both highly recognized internationally and complements the research strength of the existing AU senior researchers. Efforts are also underway to recruit a more junior faculty member.

2 Center research

The original center research plan discussed a number of main research challenges in the center focus research areas of *I/O-efficient*, *cache-oblivious* and *streaming* algorithms and *algorithm engineering*. Results and new challenges in these areas – as well as several new directions (methodologies/models) for massive data processing – have been discussed in the previous annual reports. In general 2010 was a busy year with steady progress on problems in to both the original research plan and the new directions areas. Below we *briefly* discuss *some* of the obtained results. Due to a change in Foundation guidelines and since the center has recently submitted an extensive proposal for 2011-2017 research plan, we will not go into details with research plan modifications. Note also that a more extensive outline of center results can be found in the centers recent 2007-2010 self evaluation report.

I/O-efficient algorithms

In the area of I/O-efficient algorithms, that is, algorithms designed in a two-level memory-disk model, we have continued to make progress on problems in relation to the areas outlined in the research plan.

In terms of *geometric data structures* we obtained major progress on the very fundamental orthogonal range reporting problem, that is, the problem of storing a set of d-dimensional points such that the points in an axis-aligned query hyper-box can be reported efficiently. In three dimensions our new structures improve upon previously known structures and in higher dimensions they provide the first known non-trivial structures [C125]. Furthermore, we also proved a lower bound that shows that our main d-dimensional data structure is space optimal.We have also obtained results on various variants of range reporting. For example, we have studied sorted range reporting, where the input points have weights and where a query asks for the k points with smallest weight in the query range, as well as colored versions of the problems where the points have colors and a query asks for points of a certain color. Papers with results on these problems were presented at the 2011 Symposium on Discrete Algorithms and is under submission, respectively.

In the area of *terrain data processing* we have e.g. worked on the problem of removing outlier points from "raw" terrain data, mainly in connection with massive sonar point datasets [C142]. We have also continued our work on terrain water flow modeling problems. Traditional methods for terrain flow modeling do not account for water collecting in depressions in the terrain. Instead the terrain is typically "flooded", that is, all depressions are removed, before computing how water flows over the terrain. Often this yields unrealistic flow patterns. In previous years we have developed "local terrain flooding" approaches, which remove "small" depressions before modeling flow. However, recently we managed to account for depressions (even nested depressions) much more realistically by developing an I/O-efficient algorithm that computes exactly when a depression gets filled with water (assuming uniform rain over the terrain) based on its volume and upstream area [C127]. Thus we can compute what parts of the terrain will be flooded after a certain amount

of rain and also compute more realistic flow patterns than previously. Since the algorithm is quite complicated, we have also designed a simpler approximate algorithm.
Finally, we have also continued to work on I/O-efficient *graph algorithms* and e.g. obtained results on approximating the diameter of a graph, on restricted forms of (DFS) traversals of graphs, and on topological sorting various graph classes. This work is described in a couple of papers under submission, as well as in a paper that appeared at the 2011 Workshop on Algorithm Engineering and Applications.

Cache-oblivious algorithms
Cache-obliviousness provides an elegant framework for obtaining algorithms for multi-level memory hierarchies. However, the techniques to obtain cache-oblivious algorithms and data structures and the limitations of the framework are still poorly understood. Thus in 2010 the center has continued to focus on – and obtained a number of results on – fundamental data structure questions.
We have e.g. obtained results on the fundamental *dictionary* problem, that is, the problem of maintain a collection of elements such that it can be updated and searched efficiently. As mentioned in the 2009 report, using fundamentally new techniques we have obtained an optimal cache-oblivious dictionary with an optimal trade-off between the efficiency of insertions, deletions and searches [C119]. We have also shown how to obtain a cache-oblivious dictionary that simultaneously is implicit (does not use any space beyond the space for storing the elements) and where searches satisfy the working-set property (where access to recently accessed elements are faster than accesses to not so recently accessed elements) [C141]. Finally, we have provided a more direct and intuitive proof of parts of a classical result that shows that there is an inherent asymptotic constant overhead in the searching cost of a cache-oblivious dictionary compared to the cost of searching an optimal I/O-efficient dictionary. This result has been accepted for journal publication. We have also obtained results on *range searching*, which also in previous years has been the focus of much center research. Our work on the problem has both lead to general cache-oblivious design techniques and a general understanding of the limitations of the cache-oblivious model (e.g. [J29]). In work recently presented at the 2011 Symposium on Discrete Algorithms we made further progress on the two- and three-dimensional versions of the problem by both showing an improved lower bound on the space needed for optimal range reporting data structures, and substantially reducing the size of cache-oblivious data structures for several special cases (2-d three-sided and 3-d dominance range reporting).

Streaming algorithms
Streaming algorithms are algorithms designed in a model where only one (or a small constant number of) sequential pass(es) over the data is (are) allowed.
In 2010 we have continued our work on fundamental streaming problems and general streaming algorithm design techniques as outlined in the research plan, focusing on a class of problems that can be represented in the following geometric manner: The stream of data elements is represented as a *count vector x* with an entry for each possible element equal to the number of times the element occurs in the stream. The goal of an algorithm is then to compute some function of that vector under insertions (increment of an entry) and/or deletions (decrement of an entry). This is done by computing a small *sketch* of the count vector x.
We have obtained a number of results on problems in relation to computing basic statistics. For example, for the problem of estimating the number of non-zero entries in the count vector (its L0 norm), we have developed the first optimal algorithm in a paper that received the best paper award at the 2010 Symposium on Principles of Database Systems [C112]. For the similarly well-studied problem of estimating the L1 norm (under insertions and deletions), we have presented algorithms with space bounds matching the previously best known algorithms, but with substantially better running times (in [C113] and a paper to be presented at the 2011 Symposium on Theory of Computing). We have also considered a fairly general class of problems where the goal is to estimate the distance between two vectors, and e.g. in a paper presented at the 2011 Symposium on Discrete Algorithms shown a strong lower bounds for the amount of space needed to estimate sorting-by-reversal distance (a basic notion is computational biology).
We have also studied the problem of *sparse recovery,* where the *sketch* of a (count) vector x is defined to be Ax, for some sketching matrix A. We have focused on the recovery of a *sparse approximation* to x, that is, an approximation that has as few non-zero coefficients as possible while being as close to x as possible with respect to some metric (e.g., L1). This problem has been extensively investigated in recent years, notably in the area of compressed sensing. A recent center survey gives a broader overview of the area [J16]. We have designed several new algorithms for linear sketching. For example, at the recent Symposium on Discrete Algorithms we presented new algorithms for the case where the non-zero coefficients co-occur near each other, and in a paper to be presented at the 2011 Symposium on Computational Geometry we describe a new algorithm for sketching images consisting of a small number of local geometric features (e.g., stars). In both

cases we obtained shorter sketches than previous, as well as improved running times. Finally, in a paper to be presented at the upcoming Symposium on Theory of Computing we provide the first known sparse recovery scheme under the Earth Mover Distance, a basic metric widely used in computer vision.

Algorithm engineering

Algorithm engineering covers the design and analysis of practical algorithms, efficient implementation of these algorithms, as well as experimentation that provide insight into their applicability and further improvements.

Following the research plan, we have continued the development of the libraries STXXL and TPIE for efficient implementation of I/O-efficient algorithms. We have maintained both libraries (providing bugfixes and support for new platforms, compilers and standards) and for STXXL we have also added support for flash memory, improved memory management and predictability of memory usage.

We have also continued our work on engineering I/O-efficient graph algorithms and e.g. developed new efficient heuristics for the very difficult problem of topologically sorting directed graphs. A paper with our results was presented at the 2011 Workshop on Algorithm Engineering and Applications. While topological sorting is classically solved using depth first search, the latter is equally difficult in external memory. Therefore, we also considered I/O-efficient restricted DFS traversals and its applications. We have also used experimental technique in work on bounding the average-case complexity of some classical shortest-path algorithms presented at the 2011 conference on Theory and Practice of Algorithms in Computer Systems.

Our TerraSTREAM software package for massive terrain data processing [C126], which as discussed in last year's report is being commercialized through the startup company SCALGO, continues to attract a lot of attention from industry and practitioners. During the year we have continued our implementation and experimentation with I/O-efficient terrain data processing algorithms. For example, we have both implemented the outlier detection algorithm [C142] and the simple approximate version of the algorithm for computing when depressions in a terrain fill during rainfall [C127] discussed in the I/O-algorithms section above. In fact, the outlier work, performed in collaboration with industry experts in EIVA A/S, Statoil and a few other companies, has lead to a software product called SCALGO S-CAN sold as a plugin to EIVAs NaviModel marine survey data software package. Similarly, we have gotten enthusiastic feedback from practitioners after performing preliminary experiments with the depression algorithm on selected parts of the Denmark terrain model, and we have just started an effort to quantify the realism of the results of the computation using special photos produced by COWI after a major rain event. This work is performed in a multidisciplinary collaboration with biology researchers, just as the TerraSTREAM software is also being used in a number of other multidisciplinary projects. For example, center interdisciplinary (biology) PhD student Moeslund has recently worked on the relationship between vegetation and elevation in salt meadows across Denmark and the implications for sea-level rise impacts. A paper on this work is under submission. Details about the work can also be found in Moeslund's recent MS thesis [T20].

Finally, we have intensified our work on energy-efficient sorting of large data sets. As mentioned in the 2009 annual report this work fruitfully combines our previous achievements from several areas like I/O-efficient algorithms, parallel processing and flash memory. Using our EcoSort approach we won four out of six categories in the 2010 JouleSort benchmark (www.sortbenchmark.org) for sorting 10GB to 1TB of data [C116]. In a paper just accepted, we have also reported results for the 100TB category.

New direction areas

We have continued our work in several new massive dataset areas that has been identified and discussed in previous annual reports (as well as the recent self evaluation report).

In the *parallel private-cache* model, which models modern multi-core processors, we have shown how to use ideas and techniques from I/O-algorithms to solve various fundamental graph and geometric problems [C123, C129]. In recent results presented at the 2011 Symposium on Parallel and Distributed Processing we improved our geometric results, obtaining optimal results for several problems. Very recently, we have also considered parallel distributed algorithms in the *MapReduce framework* developed by Google in order to simplify the design of algorithms for large clusters of independent but interconnected machines. Although successfully utilized by several large companies, the framework lacks a solid theoretical foundation. We have theoretically studied a number of sorting, searching and simulation problems in the framework. A paper with our results is under submission. We have also continued our work on designing theoretical models and developing algorithms for *flash memory*. This work has played a central role in our energy efficient sorting work mentioned above [C116], as well as included work on algorithms that not only minimize flash I/Os but also the time spent on deciding what block of data to evict from memory when a new block is loaded. A

paper with results of the latter is under submission. Similarly, we have obtained further results in the area of *faulty-memory algorithms*, that is, algorithms that work correctly even under memory faults. For example, we have considered the application of fault-tolerant *kd-trees* in clustering algorithms from both a theoretical and an algorithm engineering point of view [C144]. The PhD thesis of center student Jørgensen gives a nice overview of the previous faulty-memory results achieved by the center [T22]. In the area of *succinct data structures*, that is, data structures that are very space-efficient, we have recently obtained improved results on both so-called cardinal trees and counter data structures, and will present two papers on this work at the 2011 Conference on Theory and Applications of Models of Computation. We have also studied the trade-off between the space and the query time for storing a two-dimensional matrix of values such that the minimum element in a rectangular query region can be reported efficiently [C128], as well as succinct representation of dynamic sets [C141] and multi-sets [J30].

As discussed in last year's annual report, some our work is "crosscutting" in the sense that it involves ideas from several areas or combines the various models/methodologies we consider. The goal of this "model combination" work is of course to develop better and more realistic models for efficient algorithms design. Another crosscutting "theme" that has emerged in the center is an emphasis on data structure. Much of the center work in the various models described above is on data structuring problems (e.g. [C119,C124,C125,C128,C144,C141,J29,J30]). We have also considered data structure problems in more classical models of computation, including very classical problems. We have e.g. used I/O-efficient algorithms techniques to answer longstanding open problems by developing a space and query optimal three-dimensional orthogonal range searching structure and show that the query time has to increase with dimension [C124]. In the upcoming Symposium on Computational Geometry we will present further results on the problems. We have also obtained results on various special cases of range searching, such as finding the maximal weight points in a query range among weighed two-dimensional points. A paper with these results is under submission. In one dimension we have studied the complexity of data structures for finding the median element in a query range. Our results on this problem are to appear in Theoretical Computer Science (data structure) and at the 2011 Symposium on Discrete Algorithms (lower bound). Four center PhD students have also co-authored a paper on finding the most frequent element (mode) in any subarray [C117]. Other data structure results include structures for answering queries on uncertain points, that is, where each point is defined by a probability distribution. Some of our results in this area will appear at the 2011 International Conference on Database Theory.

3 Collaboration

The center continues to try to maintain a vibrant and international environment at the main center site, e.g. through emphasis on hosting international visitors (faculty as well as PhD students) at AU. All senior MIT, MPI and FRA faculty have visited AU during 2010, and all FRA and most MIT PhD-students and Post Docs have also visited. Additionally, non-center faculty Norbert Zeh (Dalhousie) and John Iacono (NYU) visited AU for a longer period of time in 2010, along with PhD student Shervin Daneshpajouh (Sharif). The list of shorter term non-center researchers visiting AU include Rolf Fagerberg (Southern Denmark), Thomas Mølhave (Duke), Mihai Pătraşcu (AT&T), Sariel Har-Peled (UIUC), Timothy Chan (Waterloo), Jeff Phillips (Utah), Inge Li Gørtz (DTU), Phillip Bille (DTU), Yakov Nekrich (Bonn), Andrew McGregor (Amherst), along with PhD students Jingxin Jin (HKUST) and Man Kwun (HKUST). The center is also seeking a strong collaboration (e.g. through hiring of joint Post Doc Verbin) with the newly formed Sino-Danish Center for the Theory of Interactive Computation (CTIC) also funded by the Danish National Research Foundation, just as it plans to intensify work on database related problems in collaboration with world-leading database researcher Professor Christian S. Jensen who was recently hired to build up a spatial database group at AU.

The center also continues to try to be a catalyst for multidisciplinary and industry collaboration. Many of the centers activities in this direction are in connection with massive terrain data, where center researchers e.g. collaborate with environmental, biodiversity and agricultural researchers at the Department of Biolog and the Faculty of Agricultural Sciences, as well as with industry partners COWI A/S, EIVA A/S and center startup SCALGO ApS. Much of the collaboration with environmental, biodiversity and agricultural researchers is in the context of *Center for Interdisciplinary Geospatial Informatics Research* (CiGIR), which last year received a seed grant from Aarhus University Research Foundation. In 2010 one Biology Post Doc (Sandel) was hired using the grant and another Post Doc has just been hired. The center has also initiated a multidisciplinary project with the State Library in Aarhus, which include joint advising of a PhD student (Sindahl), just as new collaborations in connection with the truly massive data that will be generated by the future FAIR and ESS physics experiments are being explored. Center researchers are also involved in the new interdisciplinary "Danish Platform for Large-scale Sequencing and Bioinformatics" recently funded by

a major grant from Danish National Advanced Technology Foundation ("Højteknologifonden"). Other new industry collaboration being initiated/explored includes collaboration with Draper Lab on compressive sensing for astronomical imaging and a project with Lufthansa Systems concerning flight route optimization. A comprehensive list of center collaborators can be found in Appendix A.

4 Events

During 2010 the center participated in and/or organized a large number of research events. These included internal weekly seminars at AU, a retreat for center employees, as well as a number of workshops. Externally, center researchers gave numerous presentations at international research conferences, as well as gave more than 35 invited presentations at research conferences, workshops and seminars. Center researchers have also participated in several public outreach activities. Brodal has for example lectured on massive data algorithms and algorithms in general at several primary- and high-school related events.

Following the success of the first *Workshop on Massive Data Algorithmics* (MASSIVE) held at AU in 2009 in connection with the *Symposium on Computational Geometry* (SoCG), the center organized a second workshop in connection with the 2010 SoCG in Snowbird, USA. The center is organizing the third MASSIVE in connection with the 2011 SoCG. The hope is to eventually make MASSIVE a full-fledged conference, probably co-located with one of the broader algorithms conferences. The center also continued its series of summer schools and organized an international summer school on *geometric data structures* in 2010, where four international experts lectured for around 50 participants from 26 different institutions in 14 countries. The center anticipate to organized another summer school in 2011, just as center researchers are involved in the organization of Royal Danish Academy of Science and Letters symposium on "Biodiversity in the silicon age", which brings together biodiversity and computer science researchers.

5 Research education

One key goal of the center is to train the next generation of researchers in a world-leading and international environment. Thus PhD-students and Post Docs are a very important part of the center, and the center strives to have a large population of international PhD students and Post Docs at AU.

Currently, the center houses 5 Post Docs (4 at AU, all internationals). Three of these Post Docs were hired in 2010: Brody Sandel (PhD Berkeley 2010), Qin Zhang (PhD HKUST, 2010) and Elad Verbin (PhD Tel-Aviv 2007). As mentioned in Section 3, Sandel is a Biology Post Doc working on interdisciplinary projects funded by a seed grant from Aarhus University Research Foundation and Verbin is a joint Post Doc with the Sino-Danish Center for the Theory of Interactive Computation (CTIC) working on a number of issues on the boundary between MADALGO and CTIC. Qin Zhang is working on issues in relation to many of the center core research areas (I/O-efficient, cache-oblivious and streaming algorithms). Three Post Docs also left the center in 2010: Mohammad Abam, Deepak Ajwani and Peyman Afshani. They went on to other Post Doc positions at University of Dortmund, Cork University and Dalhousie University, respectively.

Currently, the center houses 19 PhD students (11 at AU, 3 internationals). Two of these PhD students joined MADALGO in 2010 and one in 2011: Weichert (at FRA with Meyer as advisor), Carleton (at MIT with Demaine as advisor) and Sindahl Nielsen (at AU with Brodal as advisor). One of the 11 AU students (Truelsen) are currently on a one year leave-of-absence to work at SCALGO; Revsbæk who was on leave last year has now returned to his PhD study. Allan G. Jørgensen (AU with Brodal as advisor) finished his PhD study in 2010 and is now working in Danish industry (Siemens). Another PhD student Sarah Zakarias who started as a so-called honors student in 2009 chose an advisor in cryptography and is thus not affiliated with MADALGO any longer. AU PhD students Deleuran, Tsakalidis and Davoodi spent approximately a semester abroad in 2010 at Duke University, University of Waterloo and Leicester and Carleton Universities, respectively. Finally, 5 MS students have also been associated with the center in 2010.

As discussed in previous annual reports, we believe the centers Post Doc and PhD student recruitment efforts have been relatively successful, although we would like to recruit more international PhD students. Actually, the number of center PhD students is higher than the number anticipated in the center contract, and currently faculty resources is the major constraint on PhD student admission. The centers focus on research education includes exchange of Post Doc and PhD students, a 6 months stay abroad for AU PhD students, an organization of summer schools. Center Post Docs also continue to organize specialized PhD classes; in 2010 three 5 ECTS classes on I/O-efficient graph algorithms, advanced range searching, and lower bounds and information theory, respectively. Finally, the center continues to emphasize initiatives designed to create as sense of community at the main center site and among the center sites. This includes a yearly two day fall retreat, monthly center lunches at AU, as well as number of social events.

Appendix to the Annual Report

Section A: External Relations
Please list collaborations and state subject and output where relevant.

List **includes** relevant collaboration for AU as well as MIT, MPI and FRA researchers in 2010

			Collaboration with: (Please check the appropriate box)			
Collaborator Name (person and/or institution), country	**Collaboration subject**	**Output of collaboration**	**Danish universities, research groups and institutions**	**Foreign universities, research groups and institutions**	**Danish companies**	**Foreign companies**
Norbert Zeh (Dalhausie), Canada	I/O-efficeint, cache-oblivious and parallel algorithms	Publications and software		X		
BNR A/S, Denmark	GIS in traffic management				X	
Peder Klith Bøcher, Jens-Christian Svenning (Institute of Biological Sciences, AU), and Faculty of Agricultural Sciences and National Environmental Research Institute (NERI), Denmark	Collaborators and co-advisors of PhD student Jesper Erenskjold Moeslund	Publications	X			
COWI A/S (incl. Kristian Keller, Johnny Koust Rasmussen, Michael Schultz Rasmussen) and The Faculty of Agricultural Science (incl. Peder Klith Bøcher), Denmark	Efficient Handling of Massive Heterogenious Terrain Data	Efficient terrain processing algorithms and TerraSTREAM software modules	X		X	
Jan Vahrenhold (TU Dortmund), Germany and Andrew Danner (Swarthmore College), USA	TPIE	TPIE software package		X		
Eiva A/S, Denmark	Sonar data cleaning	Publication, software				X
Researcher at Aarhus and Aalborg University, Terma A/S, Systematic Software Engineering A/S, Dansk Landbrugsrådgivning, Alexandra Instititute, Denmark	Hightech foundation project "A platform for Galileo based pervasive computing"	Publications	X		X	

Scalable Algorithmics (SCALGO), Denmark	I/O-efficient terrain algorithms and software				X	
Pankaj K. Agarwal and Thomas Mølhave (Duke), USA	I/O-efficient terrain algorithms and TerraSTREAM	Grant, publications and TerraSTREAM software package		X		
Maarten Löffler (UC Irvine) and Jeff M. Phillips (Utah), USA	Uncertain geometric data	Publications		X		
Mike Goodrich (UC Irvine), USA	Algorithms for private-cache chip multiprocessors and for the MapReduce Framework	Publications		X		
Shervin Daneshpajouh and Mohammad Ghodsi (Sharif), Iran, Mohammad Ali Abam and Shayan Ehsani (Dortmund), Germany	Line simplification	Publication		X		
Andrej Brodnik (Primorska), Solvenia	Processing of massive geometric data	Grant		X		
Jeffrey Corbin (Union College), Monika Krupa (University of California Davis), Emily Dangremond (University of California, Berkeley), USA and Kevin Gaston (The University of Sheffield) and Richard Davies (The University of East Anglia), Bo Dalsgaard (University of Cambridge), Great Britain	Climate change impact	Publications		X		
Deepak Ajwani (University of Cork/IBM), Scotland	Flash Memory and parallel memory-cache algorithms			X		X
Rasmus Pagh (ITU), Denmark and Timothy Chan (Waterloo), Canada and Michai Patrascu (AT&T), USA and Kostas Tsichlas, Apostolos N. Papadopoulos (Thessaloniki), Spyros Sioutas (Ionian), Alexis Kaporis (Patras), Greece	Rang searching	Publication	X	X		X

Rajeev Raman (University of Leicester),UK and Beat Gfeller (ETH Zurich), Switzerland and Peter Sanders (Karlsruhe Institute of Technology), Germany	Range Minimum and Median Data Structures	Publications		X		
Srinivasa S. Rao (Seoul National University), South Korea and Vineet Pandey (BITS Pilani), India	Space efficient and external memory data structrues	Publications		X		
John Iacono (NYU), USA and Stefan Lagnerman (Bruxelles), Belgium and Ian Munro (Waterloo), Canada	Cache-Oblivious Dictionaries	Publication		X		
Wei Yu (Tsinghua), China	Data Structure Lower Bounds	Publication		X		
Kord Eickmeyer (Humboldt), Germany	Game Theory and Derandomization	Publication		X		
German Algorithm Engineering Cluster, Germany	Selected Topics in Alg. Engineering	Workshops		X		
Lufthansa Systems, Germany	Efficient shortest-paths computations with dynamic weights					X
Group of Peter Sanders (Karlsruhe), Germany	(1) Libraries for parallel/external computation. (2) Energy-efficient sorting	Publications, software, Sorting World records		X		
GSI Helmholtz Centre for Heavy Ion Research, Germany	Foundations of memory-efficient information processing for FAIR computing			X		
Group of Knut Reinert (FU Berlin), Germany	I/O-efficient traversal of large alignment graphs			X		
Group of Riko Jacob (TU Munich), Germany	High-Performance Matrix operations using GPUs			X		
H.Q. Ngo and A. Rudra (SUNY Buffalo), USA	Group testing	Publication		X		
A. Gilbert (Michigan), USA	Sketching, sparse recovery	Publication		X		
David Woodruff (IBM Almaden), USA	Streaming algorithms	Publication		X		

Ilias Diakonikolas (Columbia), USA	Pseudorandomness	Publication		X		
Y. Rachlin (Draper Lab), USA	Compressive sensing	Publication				X
Timothy G. Abbott (MIT), Zachary Abel (MIT), Scott D. Kominers (Harvard U.), John Iacono (Polytechnic Inst. NYU), Martin L. Demaine (MIT), Vi Hart (SUNY Stony Brook), Gregory N. Price (MIT), USA and Tomohiro Tachi (U. Tokyo), Japan and Stefan Langerman (U. Libre de Bruxelles), Belgium	Folding	Publications		X		
Noga Alon (Tel Aviv U.), Israel and Mihai Badoiu (Google), Martin Farach-Colton (Rutgers U.), MohammadTaghi Hajiaghayi (AT&T Research), USA and Anastasios Sidiropoulos (U. Toronto), Canada	Ordinal Embeddings	Publication		X		X
Stefan Langerman (U. Libre de Bruxelles), Belgium	Confluently Persistent Tries	Publication		X		
Andre Schulz (Universitat Munster), Germany	Embedding Stacked Polytopes on a Grid	Publication		X		
Jonathan Bredin (Colorado College), MohammadTaghi Hajiaghayi (AT&T Research), Daniela Rus (MIT), USA	Sensor Networks	Publication		X		X
Francisco Gomez-Martin (U. Politecnica de Madrid), Henk Meijer (Queens U.), David Rappaport (Queens U.), Godfried Toussaint, David Wood (McGill U.), Canada and Perouz Taslakian (U. Libre de Bruxelles), Terry Winograd (Stanford U.), USA.	The Distance Geometry of Music	Publication		X		

Greg Aloupis (McGill U.), Canada and Sebastien Collette, Stefan Langerman (U. Libre de Bruxelles), Belgium and Mirela Damian (Villanova U.), Robin Flatland (Siena College), Joseph O'Rourke (Smith College), Suneeta Ramaswami (Rutgers U.), USA and Vera Sacristan (U. Politecnica de Catalunya), Spain and Stefanie Wuhrer (Carleton U.), Canada	Cube-Style Modular Robots	Publication		X		
Jean Cardinal, Samuel Fiorini, Gwenael Joret, Stefan Langerman (U. Libre de Bruxelles), Belgium and Ilan Newman (U. Haifa), Israel	The Stackelberg Minimum Spanning Tree Game	Publication		X		
MohammadTaghi Hajiaghayi (AT&T Research), Tom Leighton (Akamai), USA and Hamid Mahini (Sharif U. Technology), Iran, Noga Alon (Tel Aviv U.), Israel	Network Creation Games	Publications		X		X
Martin L. Demaine (MIT), Vi Hart (vihart.com), USA	Balloon Polyhedra	Publication		X		X
MohammadTaghi Hajiaghayi (AT&T Research), USA and Ken-ichi Kawarabayashi (National Inst. Informatics), Japan	Decomposition, Approximation, and Coloring of Odd-Minor-Free Graphs	Publication		X		X
Seth Gilbert (EPFL), Rachid Guerraoui (EPFL), Switserland, Faezeh Malakouti (Sharif U.), Iran	Collaborative Scoring with Dishonest Participants	Publication		X		
Sandor Fekete (TU Braunschweig), Germany and Robert J. Lang (Lang Origami), USA	Circle Packing for Origami Design	Publication		X		

Zachary Abel (Harvard U.), Nadia M. Benbernou (MIT), Mirela Damian (Villanova U.), Martin L. Demaine (MIT), Robin Flatland (Siena College), Scott D. Kominers (Harvard U.), Robert T. Schweller (Northwestern U.), Matthew J. Patitz, Robert T. Schweller (U. Texas), Scott M. Summers (U. Wisconsin), USA	Self-Assembly	Publication		X		
Greg Aloupis (McGill U.), Canada and Jean Cardinal, Sébastien Collette, Perouz Taslakian, Stefan Langerman (U. Libre Bruxelles), Belgium and Martin L. Demaine (MIT), Muriel Dulieu (Polytechnic U.), Vi Hart (vihart.com), USA and Ruy Fabila-Monroy (U. National Autonoma Mexico), Mexico, and Ferran Hurtado, Maria Saumell, Carlos Seara (U. Polytecnica Catalunya), Spain	Matching Points with Things	Publication		X		X
E. Hawkes (Stanford), B. An (MIT), N. Benbernou (MIT), H. Tanaka (Harvard), S. Kim (MIT), D. Rus (MIT), R. Wood (Harvard), USA	Programmable matter by folding	Publication		X		
MohammadTaghi Hajiaghayi (AT&T Research), USA, Bojan Mohar (British Columbia), Canada	Approximation Algorithms via Contraction Decomposition	Publication		X		X

Takehiro Ito (Tohoku U.), Ryuhei Uehara (JAIST), Yushi Uno (Osaka Prefecture U.), Japan and Nicholas J. A. Harvey (U. Waterloo), Canada and Christos H. Papadimitriou (Berkeley), USA and Martha Sideri (Athens U. Economics and Business), Greece	Complexity of Reconfiguration Problems	Publication		X		
Sandor Fekete (TU Braunschweig), Gunter Rote (Freie U. Berlin), Nils Schweer (TU Braunschweig), Daria Schymura (Freie U. Berlin), Mariano Zelke (U. Frankfurt), Germany	Integer Point Sets Minimizing Average Pairwise L_1 Distance: What is the Optimal Shape of a Town?	Publication		X		
Daniel M. Kane (Harvard), David P. Woodruff (IBM Almaden), USA and Ely Porat (Israel), Israel	Moment Estimation in Data Streams	Publication		X		X
Daniel M. Kane (Harvard), USA	Sparse Johnson-Lindenstrauss Transform	Publications		X		
Brad Ballinger (U. California, Davis), Nadia M. Benbernou (MIT), Mirela Damian (Villanova U.), Diane Souvaine (Tufts U.), John Iacono (Polytechnic Inst. NYU), Robin Flatland (Siena College), USA and Prosenjit Bose (Carleton U.), Vida Dujmovic (McGill U.), Pat Morin (McGill U.), Anna Lubiw (U. Waterloo), Canada and Ferran Hurtado, Vera Sacristan (U. Politecnica de Catalunya), Spain and Ryuhei Uehara (JAIST), Japan	Coverage with k-Transmitters in the Presence of Obstacles	Publication		X		

Section B: Conferences

a) Please list the number of conferences, symposia, seminars etc. the Center has arranged or participated in the planning of b) Please list the number of times the Center has been invited to talk at international conferences.

List includes 2010 information for AU, as well as MIT, MPI and FRA researchers. Only invited (and e.g. not conference contributed) talks are listed.

a) Organisation of international conferences, symposia, seminars etc.

Title of event
Workshop on Massive Data Algorithmics (MASSIVE)
MADALGO Summer School on Geometric Data Structures
Dagstuhl seminar on Data Structures
Bellairs Winter Workshop on Computational Geometry

b) Invited Talks

Title of event	**Venue**	**Name(s) of participant(s)**
Dagstuhl seminar on Data Structures	Dagstuhl, Germany	Larsen, Arge, Brodal, Mehlhorn, Meyer
Workshop on Optimal Data Structures for Efficient Organization and Retrieval of Massive Spatial Data	Fredrickton, Canada	Afshani
Seminar	UC Irvine, USA	Sitchinava
Seminar	Goethe University Frankfurt, Germany	Sitchinava
Seminar	Karlsruhe Institute of Technology, Germany	Sitchinava
Seminar	Danish Acacemy of Sceince and Letters, Denmark	Arge
Seminar	Hong Kong University of Science and Technology, Hong Kong	Arge
Workshop on Geometric Computing	IIT Delhi, India	Arge

Workshop om Telemåling i Arealforvalgningen	Aarhus University, Denmark	Arge
AU IT-day	Aarhus University, Denmark	Arge
Seminar	Carleton University, Canada	Davoodi
Seminar	University of Leicester, Leicester, UK	Davoodi
Seminar	University of Waterloo, Canada	Tsakalidis
China theory week workshop	Tsinghua University, China	Zhang
Chinese-German Workshop on Algorithm Engineering	Shanghai, China	Meyer
International Conference on Mathematical Software	Kobe, Japan	Mehlhorn
Frontiers of Algorithms Workshop	Wuhan, China	Mehlhorn
Theory Day	Open University, Tel Aviv, Israel	Indyk
Latin American Theoretical Informatics Symposium	Oaxaca, Mexico	Indyk
Workshop on Modern Massive Data Sets	Stanford University, USA	Indyk
Seminar	Bonn University, Germany	Indyk
Seminar	Hebrew University, Israel	Nelson
Seminar	Technion, Israel	Nelson
Seminar	University of Maryland, USA	Nelson
Embeddings Workshop	Cambridge, UK	Indyk
Polish Combinatorics Conference	Bedlewo, Poland	Indyk
Joint Mathematics Meetings	San Francisco, USA	Demaine
Oberwolfach Graph Theory Meeting	Oberwolfach, Germany	Demaine
British Colloquium for Theoretical Computer Science	Edinburgh, Scotland	Demaine
Gathering for Gardner	Atlanta, USA	Demaine
International Workshop on Graph-Theoretic Concepts in Computer Science	Crete, Greece	Demaine

International Conference on Origami in Science, Mathematics and Education	Singapore	Demaine
Sectional Meeting, Northeastern Section, Mathematical Association of America	Providence, USA	Demaine
China-Japan Joint Conference on Computational Geometry, Graphs and Applications	Dalian, China	Demaine
Fall Workshop on Computational Geometry	Stony Brook, USA	Demaine
Seminar	University of Calgary, Canada	Demaine

Section C: Educational activities

Please list all educational activities the Center contributed to, including PhD-courses, courses at master- and bachelor-level. Also list summer schools and courses taught abroad. Please state ECTS points (if possible) and length of the course (in hours).

List only **includes** 2010 information for AU employees (as well as relevant information for MIT, MPI and FRA employees taught **outside** their home institution). PhD student TA'ing is **not** included.

Title of activity	**ECTS**	**Length of course (number of hours)**
BSc course: Algorithms and Data Strucutres 1, Spring 2010	10	49
BSc course: Algorithms and Data Strucutres 2. Spring 2010	10	49
BSc course: Computer Science in Perspective. Fall 2010		10
MSc course: Computational Geometry. Fall 2010	10	42
PhD Course: I/O-Efficient Graph Algorithms. Spring 2010	5	21
PhD Course: Advanced Range Searching. Spring 2010	5	21
PhD course: Lower Bounds and Information Theory. Fall 2010	5	21
DM Programming Contest Coaching		
NWERC Programming Contest Coaching		

Please list the number of Master Graduates and Bachelor Graduates supervised at the Center.

Number of Master Graduates	Number of Bachelor Graduates
3	3

Section D: External funding

Please list all external funding obtained by the Center Leader or Center Members. List the total amount and the partial amount allocated to the reported year.

List **only includes** information for AU employees; it includes all active/new funding in 2010.

	Funding body	**Purpose**	**Grant holder**	**Activity period**	**Granted amount in DKK**	**Partial amount allocated to the reported year**
Public Danish funds	Danish National Advanced Technology Foundation (Højteknologi-fonden)	A platform for Galileo based pervasive positioning	AU (incl Arge), AAU, Danish agricultural advisory service and several companies including Alexandra A/S, Terma A/S, and Systematic	2007-2010	~11.700.000 (AU part)	?
	Strategic Research Council (NABIIT program)	Efficient Handling of Massive Heterogeneous Terrain Data	AU (Arge), DJF and COWI A/S	2006-2010	~7.200.000	~1.000.000
	Danish Minister of Research	Elite Researcher Award	AU (for Arge)	2010-2012	1.000.000	
Private Danish funds	Aarhus Universitets Forskningsfond	Center for Interdisciplinary Geospatial Informatics Research	Faculty of Natural Sciences, AU (incl Arge)	2009-2012	2.500.000	~250.000
International funds	US Army Research Office	STREAM: Scalable Techniques for High Resolution Elevation Data Analysis and Modeling	Duke University, NCSU, and AU (Arge)	2009-2011	~2.800.000	?

	Google	European Doctoral Fellowship	Dept. of Computer Science, AU (Arge and Larsen)	2010-2013	~1.000.000	~100.000
	Slovenian Research Agency	Processing of Massive Geometric Data	University of aribor, University of Primorska, AU (Arge and Brodal) and others	2010-2013	~2.000.000	~500.000

Section E: Awards

Please list awards and prizes the Center Leader or Center Members have recieved in the reported year.

List **includes** relevant 2010 information for AU as well as MIT, MPI and FRA researchers.

Awards	**Recipient**	**Granted amount in DKK, if relevant**
Google European Doctoral Fellowship	Larsen	~1.100.000
Natural Sciences and Engineering Research Council of Canada (NSERC) postdoctoral fellowship	Afshani	~500.000
Danish Minister of Research Elite Researcher Award ("Videnskabsministerens EliteForsk-Pris")	Arge	1.200.000
2010 Winner of several categories in the Sortbenchmark	Beckmann, Meyer	
European Association of Theoretical Computer Science Award	Mehlhlhorn	
Best Paper Award, Symposium on Principles of Database Systems	Nelson	
Charles & Jennifer Johnson Master's of Engineering Award in Computer Science at MIT	Berinde	
Apointed Associate Editor of IEEE Transactions on Signal Processing	Indyk	

Section F: Public outreach

Please list public outreach activities in electronic media, press, high schools, etc .

List **only includes** 2010 information for AU employees.

a) Electronic media

Specific media (TV, radio, other)	**Type of communication (interview, commentary, debate, feature program, etc.)**	**Subject**	**Contributor from the Center**
videnskab.dk	Feature	Hukommelsesfejl skal løses med algoritmer	Brodal
tv2oj.dk	Feature	Store priser til århusianske eliteforskere	Arge
videnskab.dk	Feature	Minister belønner forskere for elite-indsats	Arge
Computerworld	Feature	Dansk algoritme-forsker får 1,2 millioner kroner	Arge
cs.au	Feature video	Rollemodeller	Larsen
cs.au	Feature video	Ud af boksen - forskning i algoritmer	Arge

b) Press

Specific media (newspapers, journals, magazines, other)	**Type of communication (interview, commentary, debate, feature, etc.)**	**Subject**	**Contributor from the Center**
Jyllandsposten	Feature	Århus-forskere i top	Arge
Aarhus Stiftstidende	Feature	Århusianske forskere vælter sig i priser	Arge
Politiken	Feature	Informationssamfundet drukner i … data	Arge
Jyllandsposten	Feature	Google priser til Århus dataloger	Larsen
Århus Stiftidenden	Feature	Google priser til Århus dataloger	Larsen
Aktuel Naturvidenskab	Article	Økologi i en syndflod af data	Sandel

c) Other

Specific type of communication (presentation/lecturing at open university, high school, etc.)	**Subject**	**Contributor from the Center**
Posters at AU IT-day	Various posters describing MADALGO research	
Keynote at AU IT-day	Massive data algorithmics	Arge
Group exercises	Introduction to robotics to Primary School students	Brodal
Lecture at "Dansk Selskab for Datalogi"	External Memory Indexing Structures	Brodal
Lecture at "Universitets-Samvirket Århus"	Massive Data Algortihmics	Brodal
Lecture "Forskningsdag for Datamatikerlærere"	Massive Data Algorithmics	Brodal

Section G: Patents and applications

List the number of inventions reported to institution, submitted patent applications, granted patents etc. gained by the Center in reported year. Also list possible spin-off companies and collaborations/partners.

List **only includes** 2010 information for AU employees.

Number of inventions reported to institution	**Number of submitted patent applications**	**Number of granted patents**	**Number of mutually agreed licence, sale and**	**Names of spin-off companies established**

Section H: Publications

Please enclose, in a seperate appendix, a full publication list including all authors dating back from the center start. Divide the list in types of publications including conference proceedings as well as master and PhD theses authored by Center Members. List only accepted publications. If the publication has been peer reviewed please note in brackets "PR". Also note in brackets "CO" if the publication is co-authored by non-Center Members.

Publication list/counts **includes** relevant publications for AU as well as MIT, MPI and FRA researchers.

Total number of publications in reported year	Peer reviewed	Not peer reviewed
Number of journal articles	18	0
Number of conference proceedings	35	1
Number of monographs	0	0
Number of book chapters	0	0
Others	0	10

List the 10 most prestigious publication sources within the Center's research area and prioritize.

Conferences

1. ACM Symposium on Theory of Computing (STOC)
2. IEEE Symposium on Foundations of Computer Science (FOCS)
3. ACM-SIAM Symposium on Discrete Algorithms (SODA)
4. Symposium on Computational Geometry (SoCG)
5. International Colloquium on Automata, Languages, and Programming (ICALP)
6. European Symposium on Algorithms (ESA)
7. ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)
8. International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)/ International Workshop on Randomizationand Computation (RANDOM)
9. Scandinavian Workshop on Algorithm Theory (SWAT)/Workshop on Algorithms and Data Structures (WADS)
10. Workshop on Algorithm Engineering and Experiments (ALENEX)

Journals

1. Journal of the ACM
2. SIAM Journal on Computing
3. ACM Transactions on Algorithms
4. Discrete & Computational Geometry
5. Algorithmica
6. Journal of Computer and System Sciences
7. Computational Geometry: Theory and Applications
8. ACM Journal of Experimental Algorithmics
9. Theoretical Computer Science
10. Journal of Discrete Algorithms

State information regarding any bibliometric analyses about the Center.

Please refer to center 2007-2010 self evaluation report

Section I: Publication list

Conference proceedings

C1	2007	B. Escoffier, G. Moruz and A. Ribichini	Adapting Parallel Algorithms to the W-Stream Model, with Applications to Graph Problems	Proc. International Symposium on Mathematical Foundations of Computer Science (MFCS)	(PR)(CO)
C2	2007	S. Guha, P. Indyk and A. McGregor	Sketching Information Divergences	Proc. Annual Conference on Learning Theory (COLT)	(PR)(CO)
C3	2007	G. S. Brodal and A. G. Jørgensen	A Linear Time Algorithm for the k Maximal Sums Problem	Proc. International Symposium on Mathematical Foundations of Computer Science (MFCS)	(PR)(CO)
C4	2007	G. S. Brodal, L. Georgiadis, K. A. Hansen and I. Katriel	Dynamic Matchings in Convex Bipartite Graphs	Proc. International Symposium on Mathematical Foundations of Computer Science (MFCS)	(PR)(CO)
C5	2007	G. Jørgensen, G. Moruz and T. Mølhave	Resilient Priority Queues	Proc. International Workshop on Algorithms and Data Structures (WADS)	(PR)
C6	2007	G. S. Brodal, R. Fagerberg, I. Finocchi, F. Grandoni, G. Italiano, A. G. Jørgensen, G. Moruz and T. Mølhave	Optimal Resilient Dynamic Dictionaries	Proc. European Symposium on Algorithms (ESA)	(PR)(CO)
C7	2007	P. K. Agarwal, L. Arge, A. Danner, H. Mitasova, T. Mølhave and K. Yi	TerraStream: From Elevation Data to Watershed Hierarchies	Proc. ACM International Symposium on Advances in Geographical Information Systems (ACM-GIS)	(PR)(CO)
C8	2007	M. Patrascu and Mikkel Thorup	Planning for Fast Connectivity Updates	Proc. IEEE Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)

C9	2007	G. Franceschini, S. Muthukrishnan, and M. Patrascu	Radix Sorting With No Extra Space	Proc. European Symposium on Algorithms (ESA)	(PR)(CO)
C10	2007	E. D. Demaine, S. Mozes, B. Rossman and O. Weimann	An Optimal Decomposition Algorithm for Tree Edit Distance	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)
C11	2007	M. A. Bender, M. Farach-Colton, J. T. Fineman, Y. Fogel, B. C. Kuszmaul and J. Nelson	Cache-Oblivious Streaming B-trees	Proc. ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)	(PR)(CO)
C12	2007	E. D. Demaine, M. Ghodsi, M. Hajiaghayi, A. S. Sayedi-Roshkhar and M. Zadimoghaddam	Scheduling to Minimize Gaps and Power Consumption	Proc. ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)	(PR)(CO)
C13	2007	M. Patrascu	Lower Bounds for 2-Dimensional Range Counting	Proc. ACM Symposium on Theory of Computing (STOC)	(PR)
C14	2007	G. M. Landau, D. Tsur and O. Weimann	Indexing a Dictionary for Subset Matching Queries	Proc. Symposium on String Processing and Information Retrieval (SPIRE)	(PR)(CO)
C15	2007	T. Friedrich and D. Ajwani	Average-Case Analysis of Online Topological Ordering	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)
C16	2007	K. Chang	Multiple pass streaming algorithms for learning mixtures of distributions in R^d	Proc. Algorithmic Learning Theory (ALT)	(PR)
C17	2007	M. Westergaard, L. M. Kristensen, G. S. Brodal and L. Arge	The ComBack Method - Extending Hash Compaction with Backtracking	Proc. International Conference on Applications and Theory of Petri Nets and Other Models of Concurrency (ICATPN)	(PR)
C18	2007	M. A. Bender, G. S. Brodal, R. Fagerberg, R. Jacob and E. Vicari	Optimal Sparse Matrix Dense Vector Multiplication in the I/O-Model	Proc. ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)	(PR)(CO)
C19	2007	A. Golynski, R. Grossi, A. Gupta, R. Raman and S. S. Rao	On the Size of Succinct Indices	Proc. European Symposium on Algorithms (ESA)	(PR)(CO)

C20	2007	M. Olsen	Nash Stability in Additively Separable Hedonic Games is NP-hard	Proc. Conference on Computability in Europe (CiE)	(PR)
C21	2008	M. Ruzic and P. Indyk	Near-Optimal Sparse Recovery in the L1 norm	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)
C22	2008	M. Patrascu	(Data) STRUCTURES	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)
C23	2008	M. Patrascu	Succincter	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)
C24	2008	E. Demaine, S. Langerman and E. Price	Confluently Persistent Tries for Efficient Version Control	Proc. Scandinavian Workshop on Algorithm Theory (SWAT)	(PR)(CO)
C25	2008	D. Ajwani, I. Malinger, U. Meyer and S. Toledo	Characterizing the Performance of Flash Memory Storage Devices and Its Impact on Algorithm Design	Proc. Workshop on Experimental Algorithms (WEA)	(PR)(CO)
C26	2008	U. Meyer	On Dynamic Breadth-First Search in External-Memory	Proc. Symposium on Theoretical Aspects (STACS)	(PR)
C27	2008	U. Meyer	On Trade-Offs in External-Memory Diameter Approximation	Proc. Scandinavian Workshop on Algorithm Theory (SWAT)	(PR)
C28	2008	G. S. Brodal and A. G. Jørgensen	Selecting Sums in Arrays	Proc.International Symposium on Algorithms and Computation (ISAAC)	(PR)
C29	2008	L. Arge, G. S. Brodal and S. S. Rao	External Memory Planar Point Location with Logarithmic Updates	Proc. Symposium on Computational Geometry (SoCG)	(PR)
C30	2008	A. Golynski, R. Raman and S. S. Rao	On the Redundancy of Succinct Data Structures	Proc. Scandinavian Workshop on Algorithm Theory (SWAT)	(PR)(CO)

C31	2008	M. Olsen	The Computational Complexity of Link Building	Proc. International Conference on Computing and Combinatorics (COCOON)	(PR)
C32	2008	M.A. Abam, M. de Berg and J. Gudmundsson	A Simple and Efficient Kinetic Spanner	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C33	2008	L. Arge, M.T. Goodrich, M. Nelson and N. Sitchinava	Fundamental Parallel Algorithms for Private-Cache Chip Multiprocessors	Proc. Symposium on Parallelism in Algorithms and Architectures (SPAA)	(PR)(CO)
C34	2008	L. Arge, T. Moelhave and N. Zeh	Cache-Oblivious Red-Blue Line Segment Intersection	Proc. European Symposium on Algorithm (ESA)	(PR)(CO)
C35	2008	P.K. Agarwal, L. Arge, T. Moelhave and B. Sadri	I/O-efficient Algorithms for Computing Contour Lines on a Terrain	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C36	2008	J. Feldman, S. Muthukrishnan, A. Sidiropoulos, C. Stein and Z. Svitkina	On Distributing Symmetric Streaming Computations	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C37	2008	P. Indyk	Explicit Constructions for Compressed Sensing of Sparse Signals	Proc Symposium on Discrete Algorithms (SODA)	(PR)
C38	2008	A. Andoni, P. Indyk and R. Krauthgamer	Earth Mover Distance over High-Dimensional Spaces	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C39	2008	P. Indyk and A. McGregor	Declaring Independence via the Sketching of Sketches	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C40	2008	K. Onak and A. Sidiropoulos	Circular Partitions with Applications to Visualization and Embeddings	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C41	2008	J. Matousek and A. Sidiropoulos	Inapproximability for metric embeddings into R^d	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)
C42	2008	N. J. A. Harvey, J. Nelson and K. Onak	Sketching and Streaming Entropy via Approximation Theory	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)

C43	2008	A. Andoni, D. Croitoru and M. Patrascu	Hardness of Nearest Neighbor under L-infinity	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)
C44	2008	T. Chan, M. Patrascu and L. Roditty	Dynamic Connectivity: Connecting to Networks and Geometry	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)
C45	2008	S. Mozes, K. Onak and Oren Weimann	Finding an Optimal Tree Searching Strategy in Linear Time	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C46	2008	A. Chakrabarti, T.S. Jayram and M. Patrascu	Tight Lower Bounds for Selection in Randomly Ordered Streams	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C47	2008	E. Demaine, T. Ito, Ni. J. A. Harvey, C. H. Papadimitriou, M. Sideri, R. Uehara and Yushi Uno	On the Complexity of Reconfiguration Problems	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)(CO)
C48	2008	E. Demaine, G. Aloupis, S. Collette, S. Langerman, V. Sacristan and S. Wuhrer	Reconfiguration of Cube-Style Modular Robots Using O(log n) Parallel Moves	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)(CO)
C49	2008	E. Demaine, M. Buadoiu, M. Hajiaghayi, A. Sidiropoulos and M. Zadimoghaddam	Ordinal Embedding: Approximation Algorithms and Dimensionality Reduction	Proc. International Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)	(PR)(CO)
C50	2008	E. Demaine, T. G. Abbott, Z. Abel, D. Charlton, M. L. Demaine and S. D. Kominers	Hinged Dissections Exist	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C51	2008	E. R. Hansen, S. S. Rao and P. Tiedemann	Compressing Binary Decision Diagrams	European Conference on Artificial Intelligence (ECAI)	(PR)(CO)
C52	2008	R. Berinde, P. Indyk and M. Ruzic	Practical Near-Optimal Sparse Recovery in the L1 Norm (invited paper)	Proc. Allerton Conference	(CO)

C53	2008	R. Berinde, A. Gilbert, P. Indyk, H. Karloff and M. Strauss	Combining Geometry and Combinatorics: A Unified Approach to Sparse Signal Recovery (invited paper)	Proc. Allerton Conference	(CO)
C54	2008	M.A. Abam, M. de Berg, and S-H. Poon	Fault-Tolerant Conflict-Free Coloring	Proc. Canadian Conference on Computational Geometry	(CO)
C55	2009	R. Berinde, G. Cormode, P. Indyk and M. Strauss	Space-optimal Heavyhitters with Strong Error Bounds	Proc. Symposium on Principles of Database Systems (PODS)	(PR)(CO)
C56	2009	V. Cevher, C. Hegde, P. Indyk and R. G. Baraniuk	Recovery of Clustered Sparse Signal from Compressive Measurements	Proc. International Conference on Sampling Theory and Applications (SAMPTA)	(PR)(CO)
C57	2009	E. Demaine, G. Landau and O. Weimann	On Cartesian Trees and Range Minimum Queries	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)
C58	2009	D. Hermelin, G. M. Landau, S. Landau and O. Weimann	A Unified Algorithm for Accelerating Edit-Distance Computation via Text-Compression	Proc. International Symposium on Theoretical Aspects of Computer Science (STACS)	(PR)(CO)
C59	2009	A. Kovacs, U. Meyer, G. Moruz and A. Negoescu	Online Paging for Flash Memory Devices	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)
C60	2009	G. Brodal, A. Jørgensen, G. Moruz and T. Mølhave	Counting in the Presence of Memory Faults	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)
C61	2009	D. Ajwani, A. Beckmann, R. Jacob, U. Meyer and G. Moruz	On Computational Models for Flash Memory Devices	Proc. Symposium on Experimental Algorithms (SEA)	(PR)(CO)
C62	2009	U. Meyer and V. Osipov	Design and Implementation of a Practical I/O-efficient Shortest Paths Algorithm	Proc. Workshop on Algorithm Engineering and Experiments (ALENEX)	(PR)

C63	20009	U. Meyer	Via Detours to I/O-Efficient Shortest Paths	Proc. Efficient Algorithms - Essays dedicated to Kurt Mehlhorn on the Occasion of his 60th birthday	
C64	2009	D. Ajwani, R. Dementiev, U. Meyer and V. Osipov	Breadth First Search on Massive Graphs	Proc. Ninth DIMACS Implementation Challenge: The Shortest Path Problem	(PR)
C65	2009	A. Beckmann, R. Dementiev and J. Singler	Building a Parallel Pipelined External Memory Algorithm Library	Proc. International Symposium on Parallel and Distributed Processing (IPDPS)	(PR)
C66	2009	G. S. Brodal and A. Jørgensen	Data Structures for Range Median Queries	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)
C67	2009	G. S. Brodal, R. Fagerberg, M. Greve and A. López-Ortiz	Online Sorted Range Reporting	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)(CO)
C68	2009	G. S. Brodal, A. Kaporis, S. Sioutas, K. Tsakalidis and K. Tsichlas	Dynamic 3-sided Planar Range Queries with Expected Doubly Logarithmic Time	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)(CO)
C69	2009	G. S. Brodal, A. Jørgensen and T. Mølhave	Fault Tolerant External Memory Algorithms	Proc. Algorithms and Data Structures Symposium (WADS)	(PR)
C70	2009	A. Kaporis, A.N. Papadopoulos, S. Sioutas, K. Tsakalidis and K. Tsichlas	Efficient Processing of 3-Sided Range Queries with Probabilistic Guarantees	Proc. International Conference on Database Theory (ICDT)	(PR)(CO)
C71	2009	M. Abam, M. de Berg, M. Farshi, J. Gudmundsson and M. Smid	Geometric Spanners for Weighted Point Sets	Proc. European Symposium on Algorithms (ESA)	(PR)(CO)
C72	2009	M. Abam and M. de Berg	Kinetic Spanners in R^d	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C73	2009	M. Abam, P. Carmi, M. Farshi and M. Smid	On the Power of the Semi-Separated Pair Decomposition	Proc. Algorithms and Data Structures Symposium (WADS)	(PR)(CO)
C74	2009	D. Ajwani	On P-complete Problems in Memory Hierarchy Models	Proc. Workshop on Massive Data Algorithmics (MASSIVE)	

C75	2009	A. Farzan, R. Raman and S. Srinivasa Rao	Universal Succinct Representations of Trees?	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)
C76	2009	R. Pagh and S. Srinivasa Rao	Secondary Indexing in One Dimension: Beyond B-trees and Bitmap Indexes	Proc. Symposium on Principles of Database Systems (PODS)	(PR)(CO)
C77	2009	R. Grossi, A. Orlandi, R. Raman and S. Srinivasa Rao	More Haste, Less Waste: Lowering the Redundancy in Fully Indexable Dictionaries	Proc. International Symposium on Theoretical Aspects of Computer Science (STACS)	(PR)(CO)
C78	2009	J. E. Moeslund, P. K. Bøcher, J.-C. Svenning, T. Mølhave and L. Arge	Impacts of 21st Century Sea-level Rise on a Danish Major City – An Assessment Based on Fine-resolution Digital Topography and a New Flooding Algorithm	IOP Conference Series: Earth and Environmental Science 8	(PR)
C79	2009	M. de Berg and P. Hachenberger	Rotated-Box Trees: A Lightweight c-Oriented Bounding-Volume Hierarchy	Proc. International Symposium on Experimental Algorithms (SEA)	(PR)(CO)
C80	2009	P. Afshani, L. Arge and K. Dalgaard Larsen	Orthogonal Range Reporting in Three and Higher Dimensions	Proc Symposium on Foundations of Computer Science (FOCS)	(PR)
C81	2009	P. Afshani, C. Hamilton and N. Zeh	A Unified Approach for Cache-Oblivious Range Reporting and Approximate Range Counting	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C82	2009	P. Afshani, C. Hamilton and N. Zeh	Cache-Oblivious Range Reporting With Optimal Queries Requires Superlinear Space	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C83	2009	P. Afshani, J. Barbay and T. Chan	Instance-optimal Geometric Algorithms	Proc Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)
C84	2009	L. Arge, M.T. Goodrich and N. Sitchinava	Parallel External Memory Model	Proc. Workshop on Theory and Many-Cores	

C85	2009	L. Arge and M. Revsbæk	I/O-Efficient Contour Tree Simplification	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)
C86	2009	A. Andoni, P. Indyk, R. Krauthgamer and H.L. Nguyen	Approximate Line Nearest Neighbor in High Dimensions	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C87	2009	A. Andoni, P. Indyk and R. Krauthgamer	Overcoming the L1 Non-embeddability Barrier: Algorithms for Product Metrics	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C88	2009	R. Berinde and P. Indyk	Sequential Sparse Matching Pursuit	Proc. Allerton Conference	(PR)(CO)
C89	2009	A. Andoni, K. Do Ba, P. Indyk and D. Woodruff	Efficient Sketches for Earth-Mover Distance, with Applications	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)
C90	2009	A. Andoni, P. Indyk, K. Onak and R. Rubinfeld	External Sampling	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)
C91	2009	E. Demaine, M. Demaine, G. Konjevod and R. Lang	Folding a Better Checkerboard	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)(CO)
C92	2009	J. Cardinal, E. Demaine, M. Demaine, S. Imahori, S. Langerman and R. Uehara	Algorithmic Folding Complexity	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)(CO)
C93	2009	E. Demaine, M. Hajiaghayi, and D. Marx	Minimizing Movement: Fixed-Parameter Tractability	Proc. European Symposium on Algorithms (ESA)	(PR)(CO)
C94	2009	B. Ballinger, D. Charlton, E. Demaine, M. Demaine, J. Iacono, C-H. Liu and S-H. Poon	Minimal Locked Trees	Proc. Algorithms and Data Structures Symposium (WADS)	(PR)(CO)
C95	2009	E. Demaine, D. Kane and G. Price	A Pseudopolynomial algorithm for Alexandrov's Theorem	Proc. Algorithms and Data Structures Symposium (WADS)	(PR)(CO)
C96	2009	T. Ito, M. Kaminski and E. Demaine	Reconfiguration of List Edge-Colorings in a Graph	Proc. Algorithms and Data Structures Symposium (WADS)	(PR)(CO)

C97	2009	E. Demaine, M. Hajiaghayi and K. Kawarabayashi	Approximation Algorithms via Structural Results for Apex-Minor-Free Graphs	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)
C98	2009	E. Demaine, M. Hajiaghayi and P. Klein	Node-Weighted Steiner Tree and Group Steiner Tree in Planar Graphs	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)
C99	2009	E. Demaine, G. Borradaile and S. Tazari	Polynomial-Time Approximation Schemes for Subset-Connectivity Problems in Bounded-Genus Graphs	Proc. International Symposium on Theoretical Aspects of Computer Science (STACS)	(PR)(CO)
C100	2009	E. Demaine, D. Harmon, J. Iacono, D. Kane and M. Patrascu	The Geometry of Binary Search Trees	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C101	2009	E. Demaine, K. Kawarabayashi and M. Hajiaghayi	Additive Approximation Algorithms for List-Coloring Minor-Closed Class of Graphs	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C102	2009	E. Demaine, M. Hajiaghayi, H. Mahini and M. Zadimoghaddam	The Price of Anarchy in Cooperative Network Creation Games	Proc. International Symposium on Theoretical Aspects of Computer Science (STACS)	(PR)(CO)
C103	2009	J. Cardinal, E. Demaine, S. Fiorini, G. Joret, I. Newman and O. Weimann	The Stackelberg Minimum Spanning Tree Game on Planar and Bounded-Treewidth Graphs	Proc. Workshop on Internet and Network Economics (WINE)	(PR)(CO)
C104	2009	J. McLurkin and E. Demaine	A Distributed Boundary Detection Algorithm for Multi-Robot Systems	Proc. International Conference on Intelligent Robots and Systems	(PR)(CO)
C105	2009	G. Aloupis, N. Benbernou, M. Damian, E. Demaine, R. Flatland, J. Iacono and S. Wuhrer	Efficient Reconfiguration of Lattice-Based Modular Robots	Proc. European Conference on Mobile Robots	(PR)(CO)
C106	2009	M. Ajtai, V. Feldman, A. Hassidim and J. Nelson	Sorting and Selection with Imprecise Comparisons	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)

C107	2009	R. Yuster and O. Weimann	Computing the Girth of a Planar Graph in O(n log n) time	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)(CO)
C108	2009	R. Backofen, G. Landau, M. Möhl, D. Tsur and O. Weimann	Fast RNA Structure Alignment for Crossing Input Structures	Proc. Symposium on Combinatorial Pattern Matching (CPM)	(PR)(CO)
C109	2009	P. Klein, S. Mozes and O. Weimann	Shortest Paths in Directed Planar Graphs with Negative Lengths: A Linear-Space O(n log2 n)-Time Algorithm	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C110	2010	K. Do Ba, P. Indyk, E. Price and D.P. Woodruff	Lower Bounds for Sparse Recovery	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C111	2010	P. Indyk, H.Q. Ngo and A. Rudra	Efficiently Decodable Non-adaptive Group Testing	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C112	2010	D.M. Kane, J. Nelson and D.P. Woodruff	An Optimal Algorithm for the Distinct Elements Problem	Proc. Symposium on Principles of Database Systems (PODS)	(PR)(CO)
C113	2010	J. Nelson and D.P. Woodruff	Fast Manhattan Sketches in Data Streams	Proc. Symposium on Principles of Database Systems (PODS)	(PR)(CO)
C114	2010	I. Diakonikolas, D.M. Kane and J. Nelson	Bounded Independence Fools Degree-2 Threshold Functions	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)
C115	2010	D.M. Kane, J. Nelson and D.P. Woodruff	On the Exact Space Complexity of Sketching and Streaming Small Norms	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C116	2010	A. Beckmann , U. Meyer, P. Sanders and J. Singler	Energy-Efficient Sorting using Solid State Disks	Proc. International IEEE Green Computing Conference	(PR)(CO)
C117	2010	M. Greve, A.G. Jørgensen, K.D. Larsen and J. Truelsen	Cell Probe Lower Bounds and Approximations for Range Mode	Proc. International Colloquium on Automata, Languages and Programming (ICALP)	(PR)
C118	2010	M. Olsen	Maximizing PageRank with new Backlinks	Proc. International Conference on Algorithms and Complexity (CIAC)	(PR)

C119	2010	G.S. Brodal, E. Demaine, J. T. Fineman, J. Iacono, S. Langerman and J.I. Munro	Cache-Oblivious Dynamic Dictionaries with Optimal Update/Query Tradeoff	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C120	2010	A. Kaporis, A.N. Papadopoulos, S. Sioutas, K. Tsakalidis and K. Tsichlas	Efficient Processing of 3-Sided Range Queries with Probabilistic Guarantees	Proc. International Conference on Database Theory (ICDT)	(PR)(CO)
C121	2010	M.A. Abam and S. Har-Peled	New constructions of SSPDs and their applications	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C122	2010	M.B. Kjærgaard, H. Blunck, T. Godsk, T. Toftkjær, D.L. Christensen, and K. Grønbæk	Indoor Positioning using GPS Revisited	Proc. International Conference on Pervasive Computing (Pervasive)	(PR)
C123	2010	L. Arge, M.T. Goodrich and N. Sitchinava	Parallel external memory graph algorithms	Proc. International Parallel & Distributed Processing Symposium (IPDPS)	(PR)(CO)
C124	2010	P. Afshani, L. Arge and K.D. Larsen	Orthogonal Range Reporting: Query Lower Bounds, Optimal Structures in 3-d, and Higher Dimensional Improvements	Proc. Symposium on Computational Geometry (SoCG)	(PR)
C125	2010	P. Afshani, L. Arge and K.D Larsen	I/O-Efficient Orthogonal Range Reporting in Three and Higher Dimensions	Proc. Workshop on Massive Data Algorithmics (MASSIVE)	
C126	2010	T. Mølhave, P.K. Agarwal, L. Arge and M. Revsbæk	Scalable Algorithms for Large High-Resolution Terrain Data	Proc. International Conference on Computing for Geospatial Research & Application (COM.GEO)	(PR)(CO)
C127	2010	L. Arge, M. Revsbæk and Norbert Zeh	I/O-Efficient Computation of Water Flow Across a Terrain	Proc. Symposium on Computational Geometry (SoCG)	(PR)(CO)
C128	2010	G.S. Brodal, P. Davoodi and S.S. Rao	On Space Efficient Two Dimensional Range Minimum Data Structures	Proc. European Symposium on Algorithms (ESA)	(PR)(CO)

C129	2010	D. Ajwani, N. Sitchinava and N. Zeh	Geometric Algorithms for Private-Cache Chip Multiprocessors	Proc. European Symposium on Algorithms (ESA)	(PR)(CO)
C130	2010	Z. Abel, N. Benbernou, M. Damian, E.D. Demaine, M.L. Demaine, R. Flatland, S. Kominers and R. Schwelle	Shape Replication Through Self-Assembly and RNase Enzymes	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C131	2010	E.D. Demaine, M. Hajiaghayi and K. Kawarabayashi	Decomposition, Approximation, and Coloring of Odd-Minor-Free Graphs	Proc. Symposium on Discrete Algorithms (SODA)	(PR)(CO)
C132	2010	N. Gershenfeld, D. Dalrymple, K. Chen, A. Knaian, F. Green, E.D. Demaine, S. Greenwald and P. Schmidt-Nielsen	Reconfigurable Asynchronous Logic Automata	Proc. Symposium on Principles of Programming Langauges (POPL)	(PR)(CO)
C133	2010	G. Aloupis, J. Cardinal, S. Collette, E.D. Demaine, M.L. Demaine, M. Dulieu, R. Fabila-Monroy, V. Hart, F. Hurtado, S. Langerman, M. Saumell, C. Seara and P. Taslakian	Matching Points with Things	Proc. Latin American Theoretical Informatics Symposium (LATIN)	(PR)(CO)
C134	2010	E.D. Demaine and M. Zadimoghaddam	Scheduling to Minimize Power Consumption using Submodular Functions	Proc. Symposium on Parallelism in Algorithms and Architectures (SPAA)	(PR)
C135	2010	S. Gilbert, R. Guerraoui, F. Malakouti and M. Zadimoghaddam	Collaborative Scoring in the Presence of Malicious Players	Proc. Symposium on Parallelism in Algorithms and Architectures (SPAA)	(PR)(CO)
C136	2010	N. Alon, E.D. Demaine, M. Hajiaghayi and T. Leighton	Basic Network Creation Games	Proc. Symposium on Parallelism in Algorithms and Architectures (SPAA)	(PR)(CO)
C137	2010	E.D. Demaine and M. Zadimoghaddam	Minimizing the Diameter of a Network using Shortcut Edge	Proc. Scandinavian Workshop on Algorithm Theory (SWAT)	(PR)

C138	2010	M. Bateni, M.H. Hajiaghayi and M. Zadimoghaddam	Submodular Secretary Problem and Extensions	Proc. Workshop on Approximation Algorithms for Combinatorial Optimization Problems (APPROX)	(PR)(CO)
C139	2010	B. Ballinger, N. Benbernou, P. Bose, M. Damian, E.D. Demaine, V. Dujmović, R. Flatland, F. Hurtado, J. Iacono, A. Lubiw, P. Morin, V. Sacristán, D. Souvaine and R. Uehara	Coverage with k-Transmitters in the Presence of Obstacles	Proc. International Conference on Combinatorial Optimization and Applications (COCOA)	(PR)(CO)
C140	2010	E.D. Demaine and M. Zadimoghaddam	Constant Price of Anarchy in Network Creation Games via Public Service Advertising	Proc. International Workshop on Algorithms and Models for the Web-Graph	(PR)
C141	2010	G. S. Brodal, C. Kejlberg-Rasmussen and J. Truelsen	A Cache-oblivious Implicit Dictionary with the Working Set Property	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)
C142	2010	L. Arge, K. D. Larsen, T. Mølhave and F. van Walderveen	Cleaning Massive Sonar Point Clouds	Proc. International Conference on Advances in Geographic Information System (ACM-GIS)	(PR)
C143	2010	G.S Brodal, Ss.Sioutas, K. Tsichlas and C. Zaroliagis	D2-Tree: A New Overlay with Deterministic Bounds	Proc. International Symposium on Algorithms and Computation (ISAAC)	(PR)(CO)
C144	2010	F. Gieseke, G. Moruz and J. Vahrenhold	Resilient kd-trees: K-means in space revisited	Proc. Conference on Data Mining (ICDM)	(PR)(CO)
C145	2010	J. Brody and E. Verbin	The Coin Problem and Pseudorandomness for Branching Programs	Proc. Symposium on Foundations of Computer Science (FOCS)	(PR)(CO)

Journals

J1	2007	G. S. Brodal, R. Fagerberg and G. Moruz	On the Adaptiveness of Quicksort	ACM Journal of Experimental Algorithmics, 12	(PR) (CO)

J2	2008	D. Ajwani, T. Friedrich and U. Meyer	An O(n^{2.75}) Algorithm for Incremental Topological Ordering	ACM Transactions on Algorithms, 4(4)	(PR)
J3	2008	M. Stissing, T. Mailund, C. N. S. Pedersen, G. S. Brodal and R. Fagerberg	Computing the All-Pairs Quartet Distance on a set of Evolutionary Trees	Journal of Bioinformatics and Computational Biology, 6(1)	(PR)(CO)
J4	2008	L. Arge, M. de Berg, H. J. Haverkort and K. Yi	The Priority R-Tree: A Practically Efficient and Worst-Case Optimal R-Tree	ACM Transactions on Algorithms, 4(1)	(PR)(CO)
J5	2009	M. Olsen	Nash Stability in Additively Separable Hedonic Games and Community Structures	Theory of Computing Systems, 45(4)	(PR)
J6	2009	M. Abam, M. de Berg, M. Farshi and J. Gudmundsson	Region-Fault Tolerant Geometric Spanners	Discrete & Computational Geometry, 41(4)	(PR)(CO)
J7	2009	M. Abam, M. de Berg and B. Speckmann	Kinetic kd-Trees and Longest-Side kd-Trees	SIAM Journal of Computing, 39(4)	(PR)(CO)
J8	2009	L. Arge, V. Samoladas and K. Yi	Optimal External-Memory Planar Point Enclosure	Algorithmica, 54(3)	(PR)(CO)
J9	2009	L. Arge, M. de Berg and H. Haverkort	Cache-Oblivious R-Trees	Algorithmica, 53(1)	(PR)(CO)
J10	2009	H. Iben, J. O'Brien and E. Demaine	Refolding Planar Polygons	Discrete & Computational Geometry, 41(3)	(PR)(CO)
J11	2009	E. Demaine, M. Hajiaghayi, H. Mahini, A. Sayedi-Roshkhar, S. Oveisgharan and M. Zadimoghaddam	Minimizing Movement	ACM Transactions on Algorithms, 5(3)	(PR)(CO)
J12	2009	E. Demaine, M. Hajiaghayi and K. Kawarabayashi	Algorithmic Graph Minor Theory: Improved Grid Minor Bounds and Wagner's Contraction	Algorithmica, 54(2)	(PR)(CO)
J13	2009	T. Abbott, M. Burr, T. Chan, E. Demaine, M. Demaine, J. Hugg, D. Kane, S. Langerman, J. Nelson, E. Rafalin, K. Seyboth and V. Yeung	Dynamic Ham-Sandwich Cuts in the Plane	Computational Geometry: Theory and Applications, 42(5)	(PR)(CO)

J14	2009	E.D. Demaine, M. Hajiaghayi, H. Mahini and M. Zadimoghaddam	The Price of Anarchy in Network Creation Games	ACM SIGECOM Exchanges, 8(2)	(PR)(CO)
J15	2009	E.D. Demaine, M.L. Demaine, J. Iacono and S. Langerman	Wrapping Spheres with Flat Paper	Computational Geometry: Theory and Applications, 42(8)	(PR)(CO)
J16	2010	P. Indyk and A. Gilbert	Sparse Recovery Using Sparse Matrices	Proceedings of the IEEE June 2010	(PR)(CO)
J17	2010	E.D. Demaine, S.Langerman and E. Price	Confluently Persistent Tries for Efficient Version Control	Algorithmica 57(3)	(PR)(CO)
J18	2010	M.A. Abam, M. de Berg, P. Hachenberger and A. Zarei	Streaming Algorithms for Line Simplification	Discrete & Computational Geometry 43(3)	(PR)(CO)
J19	2010	M.A. Abam, M. de Berg and J. Gudmundsson	A Simple and Efficient Kinetic Spanner	Computational Geometry: Theory and Applications 43(3)	(PR)(CO)
J20	2010	D. Ajwani and T. Friedrich	Average-case Analysis of Incremental Topological Ordering	Discrete Applied Mathematics 158	(PR)(CO)
J21	2010	H. Blunck and J. Vahrenhold	In-Place Algorithms for Computing (Layers of) Maxima	Algorithmica 57(1)	(PR)(CO)
J22	2010	P. Indyk, Z. Syed, C. Stultz, M. Kellis and J. Guttag	Motif discovery in physiological datasets: A methodology for inferring predictive elements	ACM Transactions on Knowledge Discovery in Data 4(1)	(PR)(CO)
J23	2010	E. Hawkes, B. An, N. M. Benbernou, H. Tanaka, S. Kim, E.D. Demaine, D. Rus and R.J. Wood	Programmable matter by folding	Proceedings of the National Academy of Sciences of the United States of America 107(28)	(PR)(CO)
J24	2010	J.L. Bredin, E.D. Demaine, M. Hajiaghayi and D. Rus	Deploying Sensor Networks with Guaranteed Fault Tolerance	IEEE/ACM Transactions on Networking 18(1)	(PR)(CO)
J25	2010	E.D. Demaine, J. Iacono and S. Langerman	Grid Vertex-Unfolding Orthostacks	International Journal of Computational Geometry and Applications 20(3)	(PR)(CO)
J26	2010	E.D. Demaine, S.P. Fekete, G. Rote, N. Schweer, D. Scymura and M. Zelke	Integer Point Sets Minimizing Average Pairwise L_1 Distance: What is the Optimal Shape of a Town?	Computational Geometry: Theory and Applications 44(2)	(PR)(CO)

J27	2010	R. Connelly, E.D. Demaine, M.L. Demaine, S. Fekete, S. Langerman, J. S. B. Mitchell, A. Ribó and G. Rote	Locked and Unlocked Chains of Planar Shapes	Discrete & Computational Geometry 44(2)	(PR)(CO)
J28	2010	P.K. Agarwal, L. Arge and K. Yi	I/O-Efficient Batched Union-Find and Its Applications to Terrain Analysis	ACM Transactions on Algorithms 7(1)	(PR)(CO)
J29	2010	P. Afshani, C. Hamilton and N. Zeh	A General Approach for Cache-Oblivious Range Reporting and Approximate Range Counting	Computational geometry: Theory and applications 43(8)	(PR)(CO)
J30	2010	J. Katajainen and S. S. Rao	A compact data structure for representing a dynamic multiset	Information Processing Letters 110(23)	(PR)(CO)
J31	2010	M.A. Bender, G.S. Brodal, R. Fagerberg, R. Jacob and E. Vicari	Optimal Sparse Matrix Dense Vector Multiplication in the I/O-Model	Theory of Computing Systems 47(4)	(PR)(CO)

Thesis

T1	2007	I. Brudaru	Heuristics for Average Diameter Approximation with External Memory Algorithms	MPI	MS Thesis
T2	2007	G. Moruz	Hardware-Aware Algorithms and Data Structures	AU	PhD Thesis
T3	2008	M. Patrascu	Lower Bound Techniques for Data Structures	MIT	PhD Thesis
T4	2008	A. Sidiropoulos	Computational metric embeddings	MIT	PhD Thesis
T5	2008	D. Ajwani	Traversing large graphs in realistic settings	MPI	PhD Thesis
T6	2008	K. Do Ba	Testing closeness of distributions under the EMD metric	MIT	MS Thesis
T7	2008	K. Lai	Complexity of Union-Split-Find Problems	MIT	MS Thesis

T8	2008	J. M. Larsen og M. Nielsen	En undersøgelse af algoritmer til løsning af generalized movers problem i 3D	AU	MS Thesis
T9	2008	C. Andersen	An optimal minimum spanning tree algorithm	AU	MS Thesis
T10	2008	M. Revsbæk	I/O-efficient Algorithms for Batched Union-Find with Dynamic Set Properties and its Applications to Hydrological Conditioning	AU	MS Thesis
T11	2008	A. H. Jensen	I/O-efficient Processing of LIDAR Data	AU	MS Thesis
T12	2009	Martin Olsen	Link Building	AU	PhD Thesis
T13	2009	Thomas Mølhave	Handling Massive Terrains and Unreliable Memory, AU	AU	PhD Thesis
T14	2009	Henrik B. Kirk	Searching with Dynamic Optimality: In Theory and Practice	AU	MS Thesis
T15	2009	Krzysztof Piatkowski	Implementering og udvikling af maksimum delsum	AU	MS Thesis
T16	2009	O. Weimann	Accelerating Dynamic Programming	MIT	PhD Thesis
T17	2009	Volker Weichert	Radiation parameterization of the climate model COSMO/CLM in CUDA	FRA	MS Thesis
T18	2009	R. Berinde	Advances in Sparse Signal Recovery Methods	MIT	MS Thesis
T19	2009	P. Davoodi	Two Dimensional Range Minimum Queries	AU	MS Thesis
T20	2009	K. Tsakalidis	External Memory 3-sided Planar Range Reporting and Persistent B-Trees	AU	MS Thesis

T21	2009	L. Deleuran	Polygonal Line Simplification	AU	MS Thesis
T22	2010	A. G. Jørgensen	Data Structures: Sequence Problems, Range Queries, and Fault Tolerance	AU	PhD Thesis
T23	2010	J. Moeslund	Fine-resolution geospatial modelling of contemporary and potential future plant diversity in Denmark	AU	MS Thesis
T24	2010	J. Truelsen	Working Set Implicit Dictionaries and Range Mode Lower Bounds and Approximations	AU	MS Thesis
T25	2010	M. Greve	Online Sorted Range Reporting and Approximating the Mode	AU	MS Thesis
T26	2010	D. Kjær	Range Media Algorithms	AU	MS Thesis
T27	2010	J. Suhr Christensen	Experimental Study of Kinetic Geometric t-Spanner Algorithms	AU	MS Thesis

Other

O1	2008	E. Demaine, B. Gassend, J. O'Rourke, and G. T. Toussaint	All Polygons Flip Finitely ... Right?	In "Surveys on Discrete and Computational Geometry: Twenty Years Later", Contemporary Mathematics 453	(CO)
O2	2008	A. Andoni and P. Indyk	Near-Optimal Hashing Algorithms for Approximate Nearest Neighbor in High Dimensions	Communications of the ACM, 51(1)	(CO)
O3	2008	K. Mehlhorn and P. Sanders	Algorithms and Data Structures: The Basic Toolbox	Springer Verlag	(CO)
O4	2009	D. Ajwani and U. Meyer	Design and Engineering of External Memory Traversal Algorithms for general graphs	In Algorithmic of Large and Complex Networks, Springer Verlag	(PR)

O5	2009	L. Arge and N. Zeh	External-memory Algorithms and Data Structures	In Algorithms and Theory of Computation Handbook, CRC Press	(PR)(CO)
O6	2009	R. Hearn and E. Demaine	Games, Puzzles, and Computation	A.K. Peters	(CO)
O7	2010	D. Ajwani and H. Meyerhenke	Realistic Computer Models	In Algorithm Engineering. Bridging the Gap Between Algorithm Theory and Practice, Springer Verlag	(CO)

MADALGO List of Personel 2010 *01.01.-31.12.2010*

Personel		Hiring	Finansing (fraction of year) *)			Forign	For PhD and	For PhD:
Name	Position	period in 2010 **)	Foundation	AU	Other finan-sing ***)	employee	Post Doc: Previous education	Finished degree
Centerleder								
Lars Arge (AU)	Professor	all period	0,1	0,9				
Faculty								
Gerth S. Brodal (AU)	Associate Professor	all period		1				
Piotr Indyk (MIT)	Associate Professor	all period	0,1		0,1	x		
Erik Demaine (MIT)	Associate Professor	all period	0,1		0,1	x		
Kurt Mehlhorn (MPI)	Professor	all period			0,1	x		
Ulrich Meyer (FRA)	Professor	all period			0,3	x		
Mohammad Abam (AU)	Post Doc	-31.01	0,1			x	MS, PhD	
Deepak Ajwani (AU)	Post Doc	-30.09	0,8			x	M.TECH, PhD	
Peyman Afshani (AU)	Post Doc	-31.08	0,7			x	PhD	
Nodari Sitchinava (AU)	Post Doc	all period	1			x	M.Eng., PhD	
Brody Sandel (AU)	Post Doc	01.06-			0,6	x	PhD	
Qin Zhang (AU)	Post Doc	01.08-	0,4			x	PhD	
Elad Verbin (AU)	Post Doc	01.08-	0,4			x	PhD	
Gabriel Moruz (FRA)	Post Doc	all period			1	x	MS, PhD	
Guests								
Norbert Zeh	Associate Professor	-28.02			0,4	x		
Shervin Daneshpajouh	PhD student	15.01-15.08			0,6	x		
John Iacono	Associate Professor	01.08-31.08	0,1			x		
Tehnical staff								
Thor Siiger Prentow	Programmer	all period	1					
Administrative staff								
Else Magård	Center manager	all period	1					
Ellen Lindstrøm	Accountant	all period		0,5				
Ph.d.-studerende								
Allan G. Jørgensen (AU)	PhD student	-31.01	0,1				BS + 1 year	x
Lasse Deleuran (AU)	PhD student	all period	0,4		0,6		BS + 1 year	
Kostas Tsakalidis (AU)	PhD student	all period	1			x	BS + 1 year	
Jesper Erenskjold Moeslund (AU)	PhD student	all period	0,3	0,1	0,6		BS + 1 year	
Morten Revsbæk (AU)	PhD student						Cand. Scient	On leave
Mark Greve (AU)	PhD student	all period	0,9	0,1			BS + 1 year	
Pooya Davoodi (AU)	PhD student	all period	1			x	MS	
Jacob Truelsen (AU)	PhD student	-31.07		0,6			BS + 1 yer	On leave
Kasper G. Larsen (AU)	PhD student	all period	0,4	0,6			BS	
Casper Kejlberg-Rasmussen (AU)	PhD student	all period	0,4	0,6			BS	
Freek van Walderveen (AU)	PhD student	all period	0,4		0,6	x	MS	
Andreas Beckmann (MPI/FRA)	PhD student	all period	1			x	MS	
Andrei Negoescu (MPI/FRA)	PhD student	all period			1	x	MS	
Volker Weichert (MPI/FRA)	PhD student	all period			1	x	MS	
Khan Do Ba (MIT)	PhD student	all period	0,3		0,7	x	BS	
Jelani Nelsen (MIT)	PhD student	all period			1	x	MS	
Eric Price (MIT)	PhD student	all period			1	x	BS	
Morteza Zadimoghaddam (MIT)	PhD student	all period	0,3		0,7	x	BS	
David Carlton (MIT)	PhD student	all period			1	x	BS, MA	

*) Approximation. Max one decimal.

**) More then three weeks.

***) Including no financing.