

# ECCO XXV

**25<sup>th</sup> Conference of European  
Chapter on Combinatorial Optimization**

April 26- 28, 2012  
Antalya, Turkey

**Book of Abstracts**

[www.eccoxxv.org](http://www.eccoxxv.org)

## ■ TD-03

Thursday, 15:30-17:10

Room C

### Data Mining

Stream: Combinatorial Optimization in Data Mining

Invited session

Chair: *Cem Iyigun*, Industrial Engineering, Middle East Technical University, Turkey, iyigun@ie.metu.edu.tr

#### 1 - Biclustering on Microarray Gene Expression Data

*Ozan Cinar*, Statistics, Middle East Technical University, Turkey, ocinar@metu.edu.tr, *Ozlem Ilk*, *Cem Iyigun*

Microarray gene expression arrays are widely used in biological researches. When the genes are followed at several time points, those arrays would give a time-series for each gene. Usual clustering methods, such as k-means or hierarchical clustering methods cannot be applied on time-series, since they do not consider the dependence between the values at different time points for a specific gene. We propose a method which takes this dependence into consider, and moreover, finds the interesting genes which show different patterns in different samples or conditions (e.g. control and treatment).

#### 2 - Spectral Clustering on Time Series Data

*Sipan Aslan*, Statistics, Middle East Technical University, Turkey, sipan@metu.edu.tr, *Cem Iyigun*

In order to clustering of spatial time series data using the idea of determining similarity points via using spectrum of similarity matrix is the subject matter of the study. We used turkish meteorological time series data for specifying climate regimes of Turkey. We have reported spectral clustering results on monthly total precipitation and monthly average temperature time series data obtained from Turkish State Meteorological Service of Turkey.

#### 3 - Contour Approximation of Data and a New Validity Index for Clustering

*Cem Iyigun*, Industrial Engineering, Middle East Technical University, Turkey, iyigun@ie.metu.edu.tr

Probabilistic D-clustering, recently proposed, is a probabilistic approach for clustering of data, using soft assignments of points to clusters, with membership probabilities depending on distances. We study a distance function called joint distance function (JDF), a measure of distance from all cluster centers, which monitors the progress of the algorithm evolves during the iterations. This function captures the data in its low contours and it can be a measure for finding the right number of clusters in a given dataset.

#### 4 - A new multivariate regression spline algorithm for classification problems

*Elcin Kartal Koc*, Statistics, Middle East Technical University, Department of Statistics, No:234, 06800, Ankara, Turkey, kartalelcin@gmail.com, *Cem Iyigun*

SMARS is a kind of multivariate adaptive regression spline algorithm which uses a nonlinear mapping approach for the knot selection procedure in forward stepwise step of multivariate regression spline algorithms such as MARS. The procedure leads time efficient model construction and the models obtained become less sensitive to noisy settings. In this study, SMARS, proposed for prediction problems, is now adapted to classification problems and its performance is evaluated via some performance measures and computing time.

#### 5 - Investigating the seasonal patterns of continental central anatolia by clustering

*Tülay Akal*, Statistics, Middle East Technical University, Turkey, tulay\_210@yahoo.com.tr, *Vilda Purutcuoglu Gazi*, *Inci Batmaz*, *Elcin Kartal Koc*, *Cem Iyigun*, *Ceylan Yozgatligil*

We investigate the effect of climate change on the seasonal patterns of Continental Central Anatolia region of Turkey. For this purpose, 13 different meteorological variables including total precipitation, average pressure, average vapour pressure, average cloudiness, average relative humidity and various temperatures such as minimum, maximum and average temperature recorded monthly at 52 stations from 1950 to 2010 are clustered individually and altogether as one using the hierarchical and partition around medoids (PAM) methods. Results are reported in seasonal patterns in the region.

## ■ TD-04

Thursday, 15:30-17:10

Room D

### Graph Eigenvalues and Combinatorial Optimization

Stream: Spectral Graph Theory Techniques and Applications in Combinatorial Optimization

Invited session

Chair: *Domingos Cardoso*, Departamento de Matematica, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal, dcardoso@ua.pt

#### 1 - A generalization of Fiedler's lemma and its application on graph energy

*Enide Martins*, Mathematics, University of Aveiro, University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Aveiro, Portugal, enide@ua.pt

In this work we present a generalization of a Fiedler's lemma introduced in [M. Fiedler, Eigenvalues of nonnegative symmetric matrices, Linear Algebra Appl. 9 (1974): 119-142] and this generalization is applied to the determination of eigenvalues of graphs belonging to a particular family and also to the determination of the graph energy (including lower and upper bounds).

#### 2 - Bounds for the Generalized Krein Parameters of Strongly Regular Graphs

*Vasco Mano*, Mathematics, Faculty of Sciences of University of Porto, Rua António Fragoso, 386 Custóias, 4460-669, Custóias, Portugal, vascomocomano@gmail.com, *Enide Martins*, *Luís Vieira*

We consider a strongly regular graph  $G$  with adjacency matrix  $A$  with three distinct eigenvalues. By associating a real Euclidean Jordan algebra to  $G$  we generalize the Krein parameters of a strongly regular graph and obtain some new generalized Krein conditions over the parameters of  $G$ . Finally, new upper bounds for some of the "classical" Krein parameters are obtained.

#### 3 - On the spread of the line graph and applications

*Helena Gomes*, Mathematics, University of Aveiro, 3810-100, Aveiro, Portugal, hgomes@ua.pt

In D. A. Gregory, D. Heshkowitz, S. J. Kirkland, the spread of the spectrum of a graph, *Linear Algebra Appl.*, (2001), namely the upper and lower bounds are obtained for the spread  $\lambda_1 \dots \lambda_n$  of the eigenvalues  $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_n$  of the adjacency matrix of a simple graph. Here we are concerned to obtain upper and lower bounds for the spread of the adjacency of a graph which is the line graph of a simple graph.

#### 4 - Star Sets and Graphs with Convex Quadratic Stability Number

Carlos J. Luz, Polytechnic Institute of Setúbal, Campus do IPS, Estefanilha, 2910-761, Setúbal, Portugal, carlos.luz@estsetubal.ips.pt

This talk reports on an application of the theory of star complements to the so called graphs with convex-QP stability number (which are graphs whose stability number can be determined by solving a convex quadratic programming problem). Specifically, the graphs with convex-QP stability number are characterized as those for which there exists a star set for their least eigenvalue such that the optimal values of quadratic programs associated with the graph and with the star complement corresponding to that star set coincide.

#### 5 - Maximum matching by convex quadratic programming based on an adverse graph conjecture

Maria F Pacheco, Instituto Politécnico de Bragança - ESTiG, Quinta de Santa Apolónia, Gab. 112, 5301-857, Bragança, Portugal, pacheco@ipb.pt, Domingos Cardoso, Carlos J. Luz

We describe a procedure for determining a maximum stable set in a graph with convex-QP stability number, unless there is a subgraph for which neither the optimal value of the convex quadratic program, nor the least adjacency eigenvalue changes when the neighborhood of any vertex is deleted. Assuming the truth of the conjecture, that every such adverse graph has convex-QP stability number, we introduce an algorithm for the recognition of graphs with convex-QP stability number and apply it to determine a maximum matching. Thus, we can decide if a graph has convex-QP stability number or not. So far, no counterexample for the conjecture has been found.

## Thursday, 17:30-19:10

### ■ TE-01

Thursday, 17:30-19:10

Room A

### Vehicle Routing and TSP Problems I

Stream: Vehicle Routing and TSP

Contributed session

Chair: Fidan Nuriyeva, Mathematics, Ege University, Ege Üniversitesi, 35040, İzmir, Bornova, Turkey, nuriyevafidan@gmail.com

#### 1 - The Traveling Visitor Problem and the Koper Algorithm for Solving It

Milan Djordjevic, DIST, UP FAMNIT, Glagoljaska 8, 6000, Koper, Slovenia, milandjo@gmail.com, Andrej Brodnik

We consider the problem when a visitor wants to visit all interesting sites in a city exactly once and to come back to his hotel. Since the visitors use streets, walking trails and pedestrian zones, the goal is to minimize the visitor's traveling. A new problem the Traveling Visitor Problem (TVP) is then similar to the Traveling Salesman Problem (TSP) with a difference that the traveling visitors cannot fly over buildings in the city, but instead they have to go around these obstacles. The tested benchmarks are combined from three real instances made using tourist maps of cities of Koper, Belgrade and Venice and two instances of modified cases from TSPLIB. We compare two methods for solving the TVP. In all tested cases the Koper Algorithm significantly outperforms the Naive Algorithm for solving the TVP.

#### 2 - Variants of 2-opt approach for The Generalized Traveling Salesman Problem

Thanh Luu Van, Industrial & Systems Engineering, International University, Vietnam National University - HCM city, Quarter 6, Linh Trung ward, Thu Duc district, HCM city, 1017/45 Lac Long Quan street, ward 11, Tan Binh district, HCMC, Ho Chi Minh city, Viet Nam, lvthanh@hcmiu.edu.vn

The paper introduces a composite heuristics for solving the generalized traveling salesman problem. The heuristics composes of two broad classes: (1) the constructive algorithm, and (2) the improved algorithms combined the well-known 2-opt search with the nearest neighbor heuristic and the shortest path approach. The computation results on thirty six TSPLIB problems up to 442 nodes are presented wherein the problems up to 300 nodes have been solved with computation time shorter than previous results. The author also suggests some algorithms to construct more efficient heuristics.

#### 3 - On the polytope of Bipartite TSP

Hajieh Jabbari, IE, EMU, Cyprus, Magusa, IE. dept., Cyprus, hajieh\_jabbari@yahoo.com, Bela Vizvari

Facet defining inequalities have great algorithmic importance. All of them are based on the relaxation of TSP. If optimal solution of the relaxation is not the characteristic vector of a tour then the bound can be improved by introducing a violated facet defining inequality. This paper proposes that the polytope of bipartite TSP is significantly different from that of the general TSP. Comb inequalities as facet defining inequalities of TSP are satisfied in the bipartite TSP if all degree and subtour elimination constraints are satisfied, i.e. they are not facet defining.