

KEIVAN HASSANI MONFARED - PUBLICATIONS

Properties of a nonnegative reciprocal matrix and their application to AHP

2018+

Mojtabe Eslami and Keivan Hassani Monfared
In Progress

We study the properties of a nonnegative reciprocal matrices associated with graphs and their application to AHP.

Dissonance networks and social influence

2018+

Omid Atabati, Mojtaba Eslami, and Keivan Hassani Monfared
In Progress

We model how a society manages conflicts between beliefs and social standings by forming a dissonance network, and then providing measures of centrality and modularity for such signed networks.

Community structure detection and evaluation during preictal and postictal hippocampal depth recordings

2018+

Keivan Hassani Monfared, Kris Vasudevan, Jordan. S. Farrell, and G. Cam Teskey
Under Review

We show how anti-correlation between neurons firing rates forms communities of neurons that influence the behaviour during an epileptic seizure.

Inverse spectral problems for linked vibrating systems and structured matrix polynomials

2018+

Keivan Hassani Monfared and Peter Lancaster
Under review

We show that for a given set of nk distinct real numbers Λ , and k graphs on n nodes, G_0, G_1, \dots, G_{k-1} , there are real symmetric $n \times n$ matrices A_s , $s = 0, 1, \dots, k$ such that the matrix polynomial $A(z) := A_k z^k + \dots + A_1 z + A_0$ has proper values Λ , the graph of A_s is G_s for $s = 0, 1, \dots, k-1$, and A_k is an arbitrary nonsingular (positive definite) diagonal matrix. When $k = 2$, this solves a physically significant inverse eigenvalue problem for linked vibrating systems.

An analog of Matrix Tree Theorem for signless Laplacians

2018

Keivan Hassani Monfared and Sudipta Mallik
Linear Algebra and Its Applications 560 43–55

A spanning tree of a graph is a connected subgraph on all vertices with the minimum number of edges. The number of spanning trees in a graph G is given by Matrix Tree Theorem in terms of principal minors of Laplacian matrix of G . We show a similar combinatorial interpretation for principal minors of signless Laplacian Q . We also prove that the number of odd cycles in G is less than or equal to $\frac{\det(Q)}{4}$, where the equality holds if and only if G is a bipartite graph or an odd-unicyclic graph.

A structured inverse spectrum problem for infinite graphs

2018

Keivan Hassani Monfared and Ehssan Khanmohammadi
Linear Algebra and Its Applications 539 28–43

In this paper it is shown that for a given infinite graph G on countably many vertices, and a compact, infinite set of real numbers Λ there is a real symmetric matrix A whose graph is G and its spectrum is Λ . Moreover, the set of limit points of Λ equals the essential spectrum of A , and the isolated points of Λ are eigenvalues of A with multiplicity one. It is also shown that any two such matrices constructed by our method are approximately unitarily equivalent.

**Existence of a not necessarily symmetric matrix
with given distinct eigenvalues and graph**

2017

Keivan Hassani Monfared

Linear Algebra and Its Applications 527 1–11

For given distinct numbers $\lambda_1 \pm \mu_1 i, \lambda_2 \pm \mu_2 i, \dots, \lambda_k \pm \mu_k i \in \mathbb{C} \setminus \mathbb{R}$ and $\gamma_1, \gamma_2, \dots, \gamma_l \in \mathbb{R}$, and a given graph G with a matching of size at least k , we will show that there is a real matrix whose eigenvalues are the given numbers and its graph is G . In particular, this implies that any real matrix with distinct eigenvalues is similar to a real, irreducible, tridiagonal matrix.

The nowhere-zero eigenbasis problem for a graph

2016

Keivan Hassani Monfared and Bryan L. Shader

Linear Algebra and Its Applications 505 296–312

Using previous results and methods, it is shown that for any connected graph G on n vertices and a set of n distinct real numbers Λ , there is an $n \times n$ real symmetric matrix A whose graph is G , its spectrum is Λ , and none of the eigenvectors of A have a zero entry.

**On the principal permanent rank characteristic
sequences of graphs and digraphs**

2016

Keivan Hassani Monfared, Paul Horn, Franklin H. J. Kenter,

Kathleen Nowak, John Sinkovic, and Josh Tobin

Electronic Journal of Linear Algebra 31 187–199

Given an $n \times n$ real matrix A , the principal characteristic perrank sequence of A is defined as $r_0, r_1, r_2, \dots, r_n$, where for $k \geq 1$, $r_k = 1$ iff A has a principal submatrix of size k with nonzero permanent, and $r_0 = 1$ iff A has a zero on its main diagonal. We study the following inverse problem: given a sequence $r_0 r_1 \cdots r_n$ of zeros and ones, does there exist an $n \times n$ real matrix which achieves this sequence? As a result, we characterize all the sequences corresponding to (symmetric) entry-wise nonnegative matrices, and provide some results for the skew-symmetric case.

Spectral characterization of matchings in graphs

2016

Keivan Hassani Monfared and Sudipta Mallik

Linear Algebra and Its Applications 496 407–419

A spectral characterization of the matching number (the size of a maximum matching) of a graph is given. More precisely, it is shown that the graphs G of order n whose matching number is k are precisely those graphs with the maximum skew rank $2k$ such that for any given set of k distinct nonzero purely imaginary numbers there is a real skew-symmetric matrix A with graph G whose spectrum consists of the given k numbers, their conjugate pairs and $n - 2k$ zeros.

The λ - τ structured inverse eigenvalue problem

2015

Keivan Hassani Monfared and Bryan L. Shader

Linear and Multilinear Algebra 63 2275–2300

For a matrix A let $A(\{r, s\})$ denote the principal submatrix obtained from A by removing rows and columns r and s . Let T be a tree on n vertices which satisfies some necessary combinatorial restriction, Λ a set of n distinct real numbers, M a set of $n - 2$ distinct real numbers, and r and s two distinct fixed vertices of T . Also, assume that M and L satisfy second degree strict Cauchy interlacing inequalities and some genericity conditions. Using various combinatorial techniques it is shown that there is a real symmetric matrix A whose graph is T , spectrum of A is Λ and spectrum of $A(\{r, s\})$ is M . Then, using Jacobian method this result was extended to any supergraph of this family of trees. Also, some consequences of these results related to perturbations of diagonal entries of a matrix are presented.

**Construction of real skew-symmetric matrices
from interlaced spectral data, and graph**

2015

Keivan Hassani Monfared and Sudipta Mallik

Linear Algebra and Its Applications 471 241–263

We provide analogues of the results presented in the 2013 paper for skew-symmetric matrices. This is first shown for a family of trees with nearly even branching at a vertex v (NEB trees) using various combinatorial techniques. Then the results are extended to any supergraph of such trees using the Jacobian method. Let G be a connected graph on n vertices, Λ a set of n distinct purely imaginary numbers which is closed under negation, and M a set of $n-1$ distinct purely imaginary numbers closed under negation which strictly interlaces Λ . Also, let v be a vertex of G . It is shown that if G has a spanning tree which is NEB at v , then there is a real skew-symmetric matrix A whose graph is G , its spectrum is Λ , and the spectrum of $A(v)$ is M . Some properties of NEB trees are also studied.

Construction of matrices with a given graph and prescribed interlaced spectral data

2013

Keivan Hassani Monfared and Bryan L. Shader

Linear Algebra and Its Applications 438 4348–4358

For a matrix A let $A(v)$ denote the principal submatrix obtained from A by removing its v -th row and column. In a 1989 paper, Duarte showed that for any given tree T on n vertices, Λ a set of n distinct real numbers, M a set of $n-1$ distinct real numbers that strictly interlaces Λ , and i a fixed vertex of T , there is a real symmetric matrix A whose graph is T , spectrum of A is Λ and spectrum of $A(v)$ is M . In this paper we develop a method, called the Jacobian method, and show that Duarte's result holds for any connected graph.

On the existence of nowhere-zero vectors for linear transformations

2010

Saeed Akbari, Keivan Hassani Monfared, Mohammad Jamaali, Ehssan

Khanmohammadi, and Dariush Kiani

Bulletin of the Australian Mathematical Society 82 480–487

If for a matrix A there is a vector x such that the vectors x and Ax have no zero entries, then A is called to have the AJT property. In this paper we make further progress on the Alon-Jaeger-Tarsi (AJT) Conjecture, using combinatorial, probabilistic, and linear algebraic methods. The AJT conjecture asserts any nonsingular matrix over a field with at least 4 elements has the AJT property. It is shown that any nonzero matrix is similar to an AJT matrix, and some necessary and some sufficient conditions for a matrix to have the AJT property are given. Also, we provide a sharp bound for the number of the elements of the field in terms of the size of the matrix.