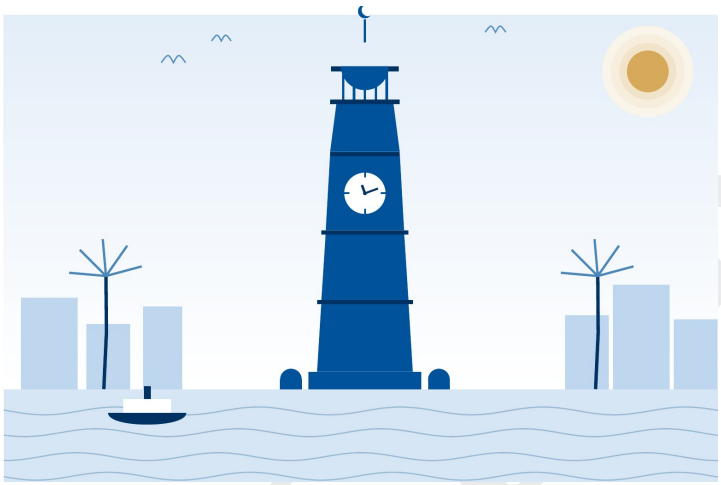
Dokuz Eylül Üniversitesi
Fen Fakültesi — Matematik Bölümü

8. İzmir Matematik Günleri



Bildiri Özetleri

Davetli Konuşmacılar

Asli Pekcan	Hacettepe Üniversitesi
Cihan Bahran	Bilkent Üniversitesi
Gökalp Alpan	Sabanci Üniversitesi
Oğuz Şavk	Orta Doğu Teknik Üniversitesi

Dokuz Eylül Üniversitesi, İzmir, Türkiye, 10-11 Eylül 2026

İzmir Matematik Günlerinin iki temel hedefinden biri yüksek lisans/doktora öğrencilerinin ve genç araştırmacıların çalışmalarını, fikirlerini ve tecrübelerini paylaşacakları, araştırma ve mentor ağları kurabilecekleri bir platform oluşturmaktır. Bir diğer hedefi ise lisans öğrencilerini, Matematik alanında akademik kariyer yapmak için cesaretlendirmektir.

2018 yılında Yaşar Üniversitesinde başlayan İzmir Matematik Günlerinin sekizincisi bu yıl Dokuz Eylül Üniversitesi ev sahipliğinde gerçekleşmiştir.

Çalıştayın her iki gününün sabah oturumları davetli konuşmacıların kendi çalışma alanlarını tanıtan kolokyum konuşmalarına, öğleden sonra oturumları ise öğrenciler ve genç araştırmacıların kısa konuşmalarına ayrılmıştır. Çalıştayda yer alan konuşmalar İngilizce veya Türkçe olup, konuşma özetlerini isim sırasına göre elinizdeki kitapçıkta bulabilirsiniz.

Son olarak, bu çalıştayın gerçekleşmesinde emeği bulunan Bilim Kuruluna, Dokuz Eylül Üniversitesi Matematik Bölümü akademik personeline teşekkür ederiz.

Düzenleme Kurulu

İzmir Matematik Günleri sırasıyla aşağıda yer alan üniversiteler tarafından düzenlenmiştir:

- 2018 Yaşar Üniversitesi
- 2019 Dokuz Eylül Üniversitesi
- 2020 Dokuz Eylül Üniversitesi
- 2022 İzmir Yüksek Teknoloji Enstitüsü
- 2023 İzmir Demokrasi Üniversitesi
- 2024 Yaşar Üniversitesi
- 2025 Ege Üniversitesi
- 2026 Dokuz Eylül Üniversitesi

Bilim Kurulu

Düzenleme Kurulu

İçindekiler

Program

10.09.2026 Perşembe		
09:30-10:00	Açılış Konuşmaları	
Davetli Konuşmacılar		
10:00-10:50	Gökalp Alpan	**Oturum B.** Fatma Serap Topal
10:50-11:10	Çay-Kahve Arası	
11:10-12:00	Aslı Pekcan	**Oturum B.** Halil Oruç
12:00-13:30	Öğle Arası	
Kısa Konuşmalar		
13:30-13:50	Ebru Aslan	**Oturum B.** Gülter Budakçı
13:50-14:10	İrem Çalım	
14:10-14:30	Koray Kekikli	
14:30-15:00	Çay-Kahve Arası	
15:00-15:20	Asel Aydın	**Oturum B.** Ahmet Yantır
15:20-15:40	Mustafa Kemal Altınbaş	
15:40-16:00	Sena Büyükdoğan	
16:00-16:20	Çay-Kahve Arası	
16:20-16:40	Begüm Yurdusev	**Oturum B.** Mustafa Özel
16:40-17:00	Hilal Demirdöğen	
17:00-17:20	Yağmur Ece Uçar	

11.09.2026 Cuma		
Davetli Konuşmacılar		
10:00-10:50	Oğuz Şavk	**Oturum B.** Aslı Güçlükan İlhan
10:50-11:10	Çay-Kahve Arası	
11:10-12:00	Cihan Bahran	**Oturum B.** Engin Mermut
12:00-13:30	Öğle Arası	
Kısa Konuşmalar		
13:30-13:50	Can Selek	**Oturum B.** Sabri Kaan Gürbüzer
13:50-14:10	Elif Sultan Koç	
14:10-14:30	Hamdi Kayaslan	
14:30-15:00	Çay-Kahve Arası	
15:00-15:20	Can Balıkçı	**Oturum B.** Münevver Pınar Eroğlu
15:20-15:40	Ekrem Şimşek	
15:40-16:00	Mert Akman	

Lokal Olmayan (Nonlokal) İntegre Edilebilir Denklemler

Aslı Pekcan

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Özet

Bu konuşmada öncelikle integrallenebilir diferansiyel denklemler ve soliton kavramı tanıtılacaktır. Solitonların tarihsel gelişimi, Korteweg–de Vries denklemi ve nonlineerlik ile dispersiyon arasındaki denge üzerinden açıklanacaktır. Ardından Ablowitz–Musslimani tipi nonlokal indirgemelerin ortaya çıkışı ve klasik integrallenebilir sistemlerle ilişkisi ele alınacaktır. Nonlineer Schrödinger (NLS) sistemi örnek olarak incelenerek nonlokal indirgemelerin nasıl elde edildiği gösterilecektir. Daha sonra Hirota bilineer yöntemi tanıtılacak ve bu yöntemin nonlokal integrallenebilir denklemlerin soliton çözümlerini elde etmedeki rolü açıklanacaktır. Son olarak NLS denklemi ve nonlokal indirgemeleri için elde edilen soliton çözümleri ile ötelenmiş nonlokal indirgemeler üzerine yapılan çalışmalar sunularak gelecekteki araştırma yönlerine değinilecektir..

Anahtar Kelimeler: Nonlokal indirgemeler, Hirota yöntemi, İntegre edilebilirlik.
Konu Sınıflandırma Numarası: 35Q51, 35Q53, 35Q55.

Temsil Teorisinde Kararlılık

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Özet

Bu konuşmada simetrik grupların temsillerinden oluşan bir dizinin kararlı/stable olmasının ne demek olduğundan ve buna dair örneklerden bahsedeceğim.

Anahtar Kelimeler: Simetrik gruplar, Temsil teorisi, Kararlılık.

A Four-Way Szegő Theorem

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Abstract

Among all monic polynomials of a fixed degree, one may minimize an L^p-norm with respect to a measure or a weighted supremum norm on a compact set. The resulting extremal polynomials include orthogonal and Chebyshev polynomials. A classical problem, going back to Szegő, is to understand how their asymptotic behavior reflects both the measure and the geometry of its support.

In this talk, I will begin with the classical real-line setting and then consider compact sets that may have infinitely many gaps and isolated points. I will discuss normalized extremal norms, usually called Widom factors, and explain how Szegő-type ideas enter their asymptotic study. The emphasis will be on general estimates and on examples illustrating the range of behavior that can occur.

Keywords: Szegő theorem, Widom factors, Orthogonal polynomials, Chebyshev polynomials.
Mathematics Subject Classification (2020): 41A17, 41A50, 42C05, 41A44.

Acknowledgment. The talk is based on joint work with Maxim Zinchenko.

A Comparison of the Homology Cobordism Group and the Floer Local Equivalence Group

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Abstract

In the first part of this talk, I will explain why the homology cobordism group is one of the central objects in low-dimensional topology. In particular, I will discuss its significance from both algebraic and geometric perspectives. In the second part, I will introduce the Floer local equivalence group, defined by Hendricks, Manolescu, and Zemke using involutive Heegaard Floer homology. The same authors showed that there is a natural homomorphism from the homology cobordism group to the Floer local equivalence group. More recently, Dai, Hom, Stoffregen, and Truong used this new group to prove that the homology cobordism group contains an infinite-rank summand. This brings us to the question of whether the structure of the homology cobordism group can be determined from the Floer local equivalence group. In the final part of the talk, I will give a negative answer to this question by showing that the kernel of the homomorphism between these two groups contains an infinite-rank subgroup.

Mathematics Subject Classification (2020): 57R58, 57R90.

Acknowledgment. This is joint work with Jaewon Lee (UT Austin).

Properties of Generalized Bézier Curves

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Abstract

Classical Bernstein polynomials and Bézier curves are fundamental tools widely used in approximation theory, Computer-Aided Geometric Design (CAGD), and differential geometry. This study investigates the theoretical and geometric characteristics of generalized Bernstein polynomials within the framework of q-calculus [1]. First, basic properties of classical Bernstein polynomials and Bézier curves are discussed; to analyze the geometric structure of these curves, the Frenet-Serret frame (unit tangent, principal normal, binormal vectors, curvature, and torsion) is introduced. Subsequently, generalized q-Bernstein polynomials [2] are given using the concepts of q-derivative and $1/q$-derivative. Within this scope, product rules for two functions and higher-order (k-th order) $1/q$-derivatives, along with related theorems [3], are derived. Finally, using the derived q-derivative rules and q-Bernstein properties, we extend the analysis to generalized q-Bézier curves to evaluate their k-th order derivative properties.

Keywords: Bernstein Polynomials, Bézier Curves, q-Calculus, Generalized Bézier Curves, Frenet-Serret Frame.
Mathematics Subject Classification (2020): 41A10, 05A30, 53A04.

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A Text Encryption Method Based on Special Number Sequences and Choi Matrix

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Abstract

This study aims to develop an original and flexible text encryption method using special number sequences and the Choi matrix. First, text data are converted into numerical values and represented as a matrix. Special sequences such as Fibonacci, Lucas [1, 2] and triangular numbers are used in this step. Then, the Choi [3] transformation is applied to the key matrices to perform the encryption. Unlike classical encryption methods, this approach uses different mathematical structures and allows dynamic key generation. Different number sequences and matrix structures can be used in each encryption process, which makes the method flexible and adaptable. The proposed model also aims to have a simpler structure and lower computational cost than complex cryptographic algorithms. This may make it useful for systems with limited processing power. The algorithm was modeled in Python and tested with different texts and number sequences. The results show that the method works and can be applied in different cases. This study shows how mathematical concepts can be used in cryptography and presents an alternative approach to text encryption.

Keywords: Cryptography, Encryption, Number sequences, Choi matrix.
Mathematics Subject Classification (2020): 94A60.

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Truncated Differential Cryptanalysis of Reduced-Round Midori64

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Abstract

Lightweight block ciphers are designed to provide efficient and secure encryption in resource-constrained environments. Among such primitives, Midori is a lightweight block cipher introduced at ASIACRYPT 2015 [1], with Midori64 and Midori128 as its two variants. In this work, we study the truncated differential behavior of the 64-bit variant, Midori64, from a mathematical and probabilistic perspective.

Differential cryptanalysis studies the propagation of differences through the successive rounds of a block cipher to identify statistical properties that can be exploited in an attack [2]. Truncated differential cryptanalysis considers only selected portions of the difference pattern while treating the remaining components as arbitrary [3]. Examining the evolution of these partially defined differences across the rounds of a cipher enables the identification of structural properties and potential vulnerabilities. Following this approach, we analyze the propagation of truncated differences through the matrix-multiplication layer of Midori64 and derive the exact probabilities associated with selected truncated differential transitions. By systematically tracking these transitions across consecutive rounds, we construct a 7-round truncated differential distinguisher. The resulting probability analysis is then used to evaluate the security of reduced-round Midori64. In particular, we obtain truncated differential attacks on 10-round and 11-round Midori64.

Keywords: Differential attack, Cryptanalysis, Truncated Differential Attack, Lightweight Block Cipher, Midori, Midori64
Mathematics Subject Classification (2020): 94A60

Acknowledgment. This work is partially supported by TÜBİTAK 1001 Project under the grant number 124F270.

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Small Covers over a Cube and Acyclic Directed Graphs

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Abstract

A small cover over an n-dimensional simple polytope P is an n-dimensional smooth closed manifold with a locally standard action of $\mathbb{Z}_2^n$ whose orbit space is homeomorphic to P. Such manifolds can be constructed using characteristic functions that assign vectors in $\mathbb{Z}_2^n$ to the facets of P. It is well-known that the Davis–Januszkiewicz equivalence classes of small covers over P can be classified in terms of characteristic functions [1].

In this talk, we consider small covers over the n-dimensional cube. The Davis–Januszkiewicz equivalence classes of such small covers are in one-to-one correspondence with acyclic directed graphs on n vertices [2]. Moreover, using cohomological rigidity, Choi et al. [3] characterized their diffeomorphism classes in terms of graph isomorphisms, local complementations, and slides. Finally, we discuss possible generalizations of this approach and related enumeration problems.

Keywords: Small cover, Acyclic digraph, Local complementation.
Mathematics Subject Classification (2020): 57S12, 05C20.

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Existence of Positive Solutions for Generalized Caputo Fractional Order p-Laplacian Boundary Value Problems

Ebru Aslan[1,†], İzel Nüzket[1,‡], Erbil Çetin[1,*], Aynur Şahin [2,**], Fatma Serap Topal [1,***]

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Abstract

In this talk, we investigate a class of nonlinear semipositone boundary value problems associated with ϖ-Caputo fractional derivatives and the p-Laplacian operator, subject to highly nonlocal integral boundary conditions inspired by [1-4]. The considered problem involves fractional derivatives of distinct orders, Stieltjes-type integrals, and multi-point conditions, giving rise to a strongly nonlocal formulation that remains insufficiently explored in the literature.

Assuming the nonlinearity is continuous and positive, we establish the existence of positive solutions by utilizing fixed point theorems on cones combined with a suitable Green's function construction.

To the best of our knowledge, these findings provide a unified and novel contribution to fractional boundary value problems with nonlocal constraints, extending semipositone analysis within the ϖ-Caputo framework.

Keywords: ϖ-Caputo fractional derivative, Boundary value problems, Existence results, Semipozitone problems, Nonlinear p-Laplacian operator.
Mathematics Subject Classification (2020): 26A33, 34B15, 34K10, 34K37, 39A10.

Acknowledgment. This work was supported by the Scientific and Technological Research Council of Türkiye (TÜBİTAK-1002-A) under Project No. 125F338.

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Grothendieck Groups of Leavitt Path Algebras Over Directed Power Graphs of Cyclic p-Groups and Dihedral Groups

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Abstract

The directed power graph $\mathrm{Pow}(G)$ of a group G is the digraph whose vertices are the elements of G, with an edge from x to y if $y = x^m$ for some integer m. In [1], we determined the Grothendieck groups of the Leavitt path algebras defined over the punctured directed power graphs $\mathrm{Pow}^*(C_{p^n})$ of cyclic p-groups. In this work, we extend these computations to the non-punctured directed power graphs $\mathrm{Pow}(C_{p^n})$. Since the Grothendieck group of a Leavitt path algebra can be determined from Smith normal form of the matrix $I - A^{\mathrm{tr}}_{\mathrm{Pow}(C_{p^n})}$, we exploit the block structure of this matrix to compute its Smith normal form and hence determine the corresponding Grothendieck group. We than use graph reductions defined in [2] to releate these directed power graphs to those of dihedral groups D_{2p^n}, obtaining an isomorphism between the corresponding dihedral groups.

Keywords: Directed power graphs, Leavitt path algebras, Grothendieck group, Smith normal form, Dihedral groups.
Mathematics Subject Classification (2020): 16S88, 05C25, 19A49.

Acknowledgment. This work was supported by The Scientific and Technological Research Council of Türkiye (Project No: TBA6/124F202).

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Proteinlerin Uzamsal Graphoid ile Modellenmesi ve Yamada Polinomu ile Analizi

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Özet

Bu konuşmada, düğüm ve graf teorisi invaryantlarının biyopolimerlerin topolojik yapılarını analiz etmedeki kullanımı ele alınacaktır. Proteinler gibi biyolojik zincirlerde ortaya çıkan karmaşık topolojik motifler, yapısal kararlılığı ve biyolojik işlevi etkileyebildiğinden, bu yapıların genişletilmiş düğüm ve graf invaryantları ile daha ayrıntılı biçimde ayırt edilmesi önem taşır. Konuşma, düğüm ve graf teorisinin temel kavramları ile bu yapıların sınıflandırılmasını sağlayan invaryantların tanıtılmasıyla başlayacaktır. Klasik düğümler, açık uçlu düğümler olan knotoidler, bağlı açık uçlu düğümler, uzamsal graflar ve açık uçlu uzamsal graflar olan graphoidler biyolojik zincirlerde ortaya çıkan farklı dolaşıklık türleri için matematiksel modeller olarak ele alınacaktır. Özellikle, Yamada polinomunun uygulaması üzerinde durulacaktır ve önerilen hesaplamalı yöntemin sonuçlarından bahsedilecektir [1,2,3]. Elde edilen sonuçların, graphoidler için Yamada polinomunun biyopolimer topolojisindeki karmaşık bağlanma örüntülerini ayırt etmek için kullanılabileceği vurgulanacaktır.

Anahtar Kelimeler: Düğüm teorisi, Graf polinomları, Protein topolojisi, Yamada polinomu.
Konu Sınıflandırma Numarası: 57K10, 05C31, 57K14, 92E10.

Not. Bu özet, Dr. Öğr. Üyesi Neslihan Gügümcü danışmanlığındaki araştırmam kapsamında, 8. İzmir Matematik Günleri'nde yapılacak kısa konuşma için hazırlanmıştır.

Kaynaklar

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Biquandle Coloring Quivers and Persistent Homology

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Abstract

In this talk, we study the relationship between biquandle coloring quivers and persistent homology in the setting of oriented virtual links. Biquandle colorings of a link diagram can be organized into a directed graph, called a biquandle coloring quiver, by using the action of selected biquandle endomorphisms on the set of colorings.

We first introduce N-directed clique complexes of quivers and the associated N-directed clique homology. We then consider increasing collections of biquandle endomorphisms, which induce filtrations of biquandle coloring quivers. Applying persistent homology to these filtrations yields new invariants that record how homological features appear and persist throughout the filtration.

In particular, persistence barcodes and additional homological data can be extracted from these filtrations to obtain invariants of oriented virtual links. Examples will be presented showing that these invariants can distinguish links that are not distinguished by the ordinary biquandle counting invariant.

Keywords: Biquandle, Quiver, Directed clique, Peristence.
Mathematics Subject Classification (2020): 57K10, 57K18.

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Rank-One Delta Interactions on Deformed Hyperspheres

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Abstract

This talk provides a step-by-step analysis of rank-one delta interactions supported on small normal deformations of n-dimensional hyperspheres.

We start by defining the rank-one interaction through the normalized surface measure on the support. This interaction couples only to the constant hyperspherical harmonic, which distinguishes it from full delta-shell potentials. Using Krein's resolvent formula, we show that the spectral problem reduces to a scalar equation.

Next, we introduce a small inward normal deformation of the hypersphere and examine its effect on the bound-state spectrum. The deformation is parametrized by a smooth function h on the unit sphere. We compute the first-order change in the principal function by pulling back the deformed surface measure to the unit sphere, expanding the plane-wave factor to first order in the deformation parameter, and performing the angular integrals using hyperspherical harmonics.

We then discuss how the resulting expression simplifies, what it implies for the bound-state energy, and how this leads to a geometric interpretation of the deformation effect. Finally, we compare the dimension-dependent features of the problem and comment on the differences between the circle case and higher-dimensional hyperspheres.

Keywords: Singular perturbations, Delta interactions, Hyperspherical harmonics, Deformed hypersurfaces.
Mathematics Subject Classification (2020): 81Q10, 81Q15, 35J10

Acknowledgment. This is joint work with Prof. Dr. Fatih Erman and Merve Nur Sayar.

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From $\mathbb{Z}$ to Discrete Graphs: An Extension of the Nehari Manifold Method

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Abstract

In this study, we first present a detailed review of the work on standing waves of discrete nonlinear Schrödinger equations with growing potentials by Zhang and Pankov [1]. Next, we examine Example 3.12 in [2], which is based on Assumption 2.5 [2] and the concept of a canonically compactifiable graph. Considering these studies, we compare the assumptions required for compact embedding in both works.

Keywords: Nonlinear Schrödinger equation, Discrete graph, Nehari manifold.
Mathematics Subject Classification (2020): 35Q55, 39A12.

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ψ-Caputo Kesirli Türevleri İçeren Bir Sınıf Üç Noktalı Sınır Değer Problemi İçin Pozitif Çözümler

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Özet

Bu çalışmada, $\alpha \in (2,3]$ mertebeden bir ψ-Caputo kesirli türevine sahip lineer olmayan üç noktalı bir sınır değer problemi için pozitif çözümlerin varlığı ve tekliğinin elde edilmesine odaklanıyoruz. Bir fonksiyona göre kesirli hesaba (fractional calculus) ait genel özelliklerin yardımıyla, sınır değer problemiyle ilişkili Green fonksiyonu açıkça elde edilmiş ve türetimin her bir cebirsel adımı eksiksiz olarak doğrulanmıştır. Elde edilen Green fonksiyonunun geometrik davranışı—herhangi bir has kompakt alt aralıktaki pozitifliği ve keskin iki taraflı sınırları da dahil olmak üzere—türev, monotonluk ve tek tepelilik (unimodality) argümanları kullanılarak kapsamlı bir şekilde incelenmiştir. Tüm negatif olmayan sürekli fonksiyonlar arasında negatif olmayan tek bir çözümün varlığını kanıtlamak için Banach daralma prensibi kullanılmıştır. Uygun bir koni tanımlanarak ve Krasnoselskii sabit nokta teoremi uygulanarak, doğrusal olmayan terim (nonlinearity) üzerindeki sublineer ve süperlineer büyüme koşulları altında, teoremdeki sırasıyla genişleme ve sıkışma durumlarına karşılık gelen en az bir kesin pozitif çözümün varlığı incelenmiştir. Sonuç olarak, karesel, logaritmik ve üstel ψ-çekirdeklerine sahip açıklayıcı örnekler sunulmuş ve ilgili tüm sabitler açıkça hesaplanmıştır.

Anahtar Kelimeler: ψ-Caputo kesirli türevi, Green fonksiyonu, Krasnoselskii sabit nokta teoremi, Pozitif çözümler, Çok noktalı sınır değer problemleri.
Konu Sınıflandırma Numarası: 34A08, 34B18, 34B10.

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Decompositions of the Representable Diagonal p-Permutation Functors and p-Nilpotency

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Abstract

Let k be an algebraically closed field of characteristic $p > 0$, and let $\mathbb{F}$ be an algebraically closed field of characteristic zero. Diagonal p-permutation functors provide a functorial framework for studying modular representations of finite groups and their blocks.[1] In particular, the notion of functorial equivalence of blocks has applications to finiteness questions in block theory and gives a natural setting for reformulations of Alperin's weight conjecture.

We aim to study an analogous functorial equivalence for groups. For a finite group G, we consider the representable diagonal p-permutation functor

$$\mathbb{F}T_G^{\Delta} = \mathbb{F}T^{\Delta}(-, G).$$

We say that two finite groups G and H are functorially equivalent if the functors $\mathbb{F}T_G^{\Delta}$ and $\mathbb{F}T_H^{\Delta}$ are isomorphic in the category of diagonal p-permutation functors.

Bouc and Yılmaz proved that the category of diagonal p-permutation functors over $\mathbb{F}$ is semisimple, hence the isomorphism class of $\mathbb{F}T_G^{\Delta}$ is determined by the multiplicities of the simple functors appearing in its decomposition. Therefore we study the decomposition of $\mathbb{F}T_G^{\Delta}$ into simple functors, and investigate how these multiplicities reflect group-theoretic properties of G. In particular, we examine the structure of the simple subfunctors of $\mathbb{F}T_G^{\Delta}$, its relation to p-nilpotency and the fusion system $\mathcal{F}_P(G)$.

Keywords: Diagonal p-permutation functors, Functorial equivalence, Finite groups, p-Nilpotency, Fusion systems
Mathematics Subject Classification (2020): 20C20, 20J15, 20D15.

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Generalized Residual Method

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Abstract

This study presents a novel "Generalized Residual Method" based on Bézier curves for the high-precision numerical solution of arbitrary-order nonlinear initial and boundary value problems. The most significant contribution of the method to the literature is that, by minimizing the constructed residual function utilizing a Taylor expansion, the unknown control points can be directly computed via successive and explicit formulas without the need to solve any algebraic or nonlinear system of equations. A theorem providing an upper bound for the error is presented. The numerical performance of the method has been tested on various high-order problems, including the Jeffery-Hamel equation encountered in fluid mechanics; it has been demonstrated that it provides both a significant reduction in error margins and high efficiency in terms of computational time (CPU) compared to traditional approaches such as the Runge-Kutta (RK4) and Homotopy Analysis Method (HAM).

Keywords: Residual method, Bézier curves, Jeffery-Hamel equation, Bersntein polynomials, Nonlinear differential equations, Error analysis.
Mathematics Subject Classification (2020): 65L05, 65L10, 65L70.

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Weighted Residual Methods

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Abstract

Because exact analytical solutions are not available for many differential equations, approximate methods play an important role in practical applications. In this study, Weighted Residual Methods (WRM) [1] are considered as an effective approach for obtaining approximate solutions of second-order differential equations. The basic idea of these methods is to construct a suitable trial solution and then reduce the resulting residual by using appropriately chosen weight (test) functions [2]. The solution procedure is presented step by step to provide a clear understanding of the underlying methodology. As an illustrative example, the methods are applied to a two-point boundary value problem, and the corresponding calculations are given in detail. In addition, Python is used for the numerical computations and graphical illustrations. The approximate solutions are compared with the exact solution to demonstrate the accuracy of the methods and to examine the corresponding errors.

Keywords: Weighted residual methods, Galerkin method, Subdomain method, Collocation method, Least squares method, Approximate solution.
Mathematics Subject Classification (2020): 65L10, 65L60.

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An Asymptotic Approach to Acoustic Green's Functions in Layered Media

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Abstract

Green's functions play an important role in the mathematical modeling of wave propagation in layered acoustic media. However, the presence of layers with different physical and acoustic properties leads to increasingly complicated expressions and may result in a considerable computational cost.

In this study, an asymptotic approach is considered for three- and four-layered acoustic media in order to obtain simplified forms of the corresponding Green's functions. Suitable small parameters are introduced to construct asymptotic approximations, and a parametric analysis is employed to further simplify the resulting expressions. The results show good agreement between the exact and approximate Green's functions. Thus, the proposed approach provides a simpler way to represent and compute Green's functions in layered media.

Keywords: Asymptotic approach, Green's function
Subject Classification: 35C20, 35A08.

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