

# The 70th Meeting of the Alabama Association of College Teachers of Mathematics

The University of South Alabama, Mobile, AL  
February 15, 2020

**The 2020 Lewis-Parker Lecture**  
*A Colorful Approach to Knot Theory*  
Daniel Silver, University of South Alabama

## ABSTRACT

Take an elastic cord, tangle it up, and then connect its ends. The result is called a knot. Two knots are regarded as the same if one can be continuously deformed so that it appears identical to the other. We can prove that two knots are the same by performing a clever deformation. But how can we tell that two knots are different? A simple — and colorful— way was found by Princeton University mathematician Ralph Fox in the 1950s. We describe “Fox colorings” of knots and show how simple linear algebra can help distinguish many pairs of knots. The ideas can be brought into the classroom and provide a wonderful introduction to topology.

**Alabama Journal of Mathematics**  
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The Alabama Journal of Mathematics is published under the auspices of the Alabama Council of Teachers of Mathematics (ACTM) and the Alabama Association of College Teachers of Mathematics (AACTM). The AJM is designed to meet a number of needs of the mathematics community in the State of Alabama. Specifically, the intent of the Journal is to knit together the various components of this mathematical community. As such, the journal includes research articles in mathematics and mathematics education appropriate for a general audience and activities and problems for K-16 mathematics teachers.

## Acknowledgements

The AACTM would particularly like to thank the University of South Alabama for graciously hosting this year’s conference. A special thank you to the local organizers: Andrei Pavelescu, Elena Pavelescu, and Cornelius Pillen. Their hard work was essential in making this years conference a success.

### AACTM Officers

President: Frank Patane, Samford University  
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## AACTM SCHEDULE

<b>8:15am–9:00am</b>	Registration
<b>9:00am–9:10am</b>	Welcome
<b>9:10am–9:25am</b>	<b>Ryan Odeneal</b> , University of South Alabama <i>Graphs With No Fully Connected Minor</i>
<b>9:30am–9:45am</b>	<b>Hoa Dinh</b> , Troy University <i>Some Geometric Properties of Matrix Means with Respect to Different Distance Functions</i>
<b>9:50am–10:05am</b>	<b>Vasiliy Prokhorov</b> , University of South Alabama <i>On Random Polynomials</i>
<b>10:10am–10:25am</b>	<b>Kwadwo Antwi-Fordjour</b> , Samford University <i>Advances in the Study of a Predator-Prey Model with Generalized Functional Response</i>
<b>10:25am–10:45am</b>	Break
<b>10:45am–11:45am</b>	<b>LEWIS-PARKER LECTURE</b> <b>Daniel Silver</b> , University of South Alabama <i>A Colorful Approach to Knot Theory</i>
<b>11:45am–1:00pm</b>	Lunch
<b>1:00pm–1:15pm</b>	<b>Scott Brown</b> , University of South Alabama <i>Web Libraries for Fully-Interactive Presentations</i>
<b>1:20pm–1:35pm</b>	<b>Will Howton and Gregory Li</b> , Alabama School of Math and Science <i>Investigation of Jørgensen’s Conjecture on <math>14</math> Vertices and <math>K_6</math> Minors in 6-connected Graphs with the Icosahedral Subgraph</i>
<b>1:40pm–1:55pm</b>	<b>Frank Patane</b> , Samford University <i>Applications of Hecke’s Formula for <math>BQF</math></i>
<b>2:00pm–2:30pm</b>	Panel Discussion on <u>Upper Level Undergraduate Mathematics Classes</u> : How and when should an introduction to proofs course be implemented in an undergraduate curriculum? What are the benefits and drawbacks of a flipped classroom for an upper level math class? What are the changes in student readiness from previous years and how can we address them?
<b>2:30pm–2:40pm</b>	Break
<b>2:40pm</b>	Business meeting

## ABSTRACTS

(in alphabetical order by speaker's name)

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### **Kwadwo Antwi-Fordjour**

Samford University

*Advances in the Study of a Predator-Prey Model with Generalized Functional Response.*

Functional response as an intake rate of a predator as a function of prey density plays a vital role in predator-prey interactions. In this talk, we consider a generalized functional response of Holling type and present new results in this area. Nonnegativity, boundedness and dissipativeness of the solutions of the model are derived analytically. Conditions under which the model has stable limit cycles are discussed. Numerical simulations are performed to verify all the analytical findings.

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### **Scott Brown**

University of South Alabama

*Web libraries for fully-interactive presentations*

Creating interactive presentations has never been easier with the maturation of HTML5, WebGL, and various web-presentation and data-visualization frameworks. We demonstrate some of the possibilities of these new technologies, discuss pros and cons, evaluate barriers to entry for non-programmers, and provide some simple templates to get started creating interactive presentations.

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### **Hoa Dinh**

Troy University

*Some Geometric Properties of Matrix Means with Respect to Different Distance Functions*

In this paper we study the monotonicity, in-betweenness and in-sphere properties of matrix means with respect to Bures-Wasserstein, Hellinger and Log-Determinant metrics. More precisely, we show that the matrix power means (Kubo-Ando and non-Kubo-Ando extensions) satisfy the in-betweenness property in the Hellinger metric. We also show that for two positive definite matrices  $A$  and  $B$ , the curve of weighted Heron means, the geodesic curve of the arithmetic and the geometric mean lie inside the sphere centered at the geometric mean with the radius equal to half of the Log-Determinant distance between  $A$  and  $B$ .

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### **Will Howton and Gregory Li**

Alabama School of Math and Science

*Investigation of Jørgensen's Conjecture on 14 Vertices and  $K_6$  Minors in 6-connected Graphs with the Icosahedral Subgraph*

Using results from Mader and Jørgensen, I am in the process of investigating whether a  $K_6$  minor must be in 6-connected, non-apex graphs of order 14 in different cases of the size of the graph. Motivated by Jørgensen's Conjecture, we investigate a class of 6-connected, 2-apex graphs on 14 vertices. This combinatorial proof shows that any such graph constructed from the icosahedral graph must contain a  $K_6$  minor and thus comply with Jørgensen's Conjecture. This is accomplished by noting the symmetry of the icosahedral graph and carefully choosing the cases considered.

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### **Ryan Odeneal**

University of South Alabama

*Graphs With No Fully Connected Minor*

A minor of a graph  $G$  is obtained through simple edge contractions, vertex deletions, and edge deletions of  $G$ . What is the structure of those graphs which do not contain fully connected graphs as minors? Little is known about the structure of such graphs without fully connected minors on 6 or greater vertices. This talk will focus on results in the field that have answered this question for certain cases and a result that Dr. Andrei Pavelescu and I have discovered.

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**Frank Patane**

Samford University

*Applications of Hecke's Formula for BQF*

In *Mathematische Werke*, Hecke defines the operator  $T_p$  and describes their utility in conjunction with theta series of quadratic forms. In particular, he shows that the image of theta series associated with classes of binary quadratic forms in  $\text{CL}(\Delta)$  is again a theta series associated to a collection of forms in  $\text{CL}(\Delta)$ . We give an explicit formula for the action of  $T_p$  on a binary quadratic form of negative discriminant and several applications that are of interest.

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**Vasily Prokhorov**

University of South Alabama

*On Random Polynomials*

In this talk we discuss properties of the sequence of monic random polynomials generated by the high-order three-term recurrence relation.