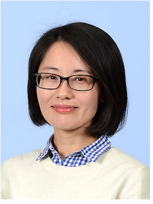
FUJIE-OKAMOTO, Futaba Associate Professor



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Membership of academic societies:

AMS (American Mathematical Society)

ICA (The Institute of Combinatorics and Its Applications)

Research Interest:

- Graph Theory

Research Summary:

Graphs have been studied through a number of aspects such as connectivity, colorings and labelings, decompositions and factorizations, traversability, etc. In my research, I study traditional concepts including those mentioned above as well as try coming up with new ways of looking at graphs that may shed some light on other concepts and problems in mathematics.

The connectivity of a connected graph is the smallest number of vertices that disconnect the graph when deleted. Menger's Theorem suggests that studying the connectivity of a graph is closely related to studying the number of internally-disjoint paths connecting each pair of vertices in the graph. In [2], a new parameter of graphs was introduced. For a nontrivial connected graph G and a nonempty non-singleton set $S \subseteq V(G)$, the number $\kappa(S)$ is the maximum number ℓ such that there is a collection $T_1, T_2, \ldots, T_\ell$ of ℓ pairwise edge-disjoint trees with $V(T_i) \cap V(T_j) = S$ for $1 \leq i \neq j \leq \ell$. The k-connectivity of G is then defined to be $\min\{\kappa(S)\}$, where the minimum is taken over all k-subsets S of $V(G)$. This generalizes the traditional concept of connectivity of graphs, where the standard connectivity is exactly the 2-connectivity. Roughly speaking, the k-connectivity of a graph can be seen as the number of "independent" ways for a set of k individuals in a network to communicate with each other.

Another popular area of research in graph theory is graph coloring. For example, the famous Four Color Theorem states that every planar graph has a proper 4-coloring. Colorings that deserve our attention include those that distinguish either every two vertices or every two adjacent vertices in a graph in some manner. Colorings possessing such properties are said to be vertex-distinguishing and neighbor-distinguishing, respectively. I have introduced and studied numerous new vertex-distinguishing colorings and neighbor-distinguishing colorings with my research partners. The sigma coloring in [1] is an example of the latter.

Major Publications:

[1] G. Chartrand, F. Okamoto, and P. Zhang, The sigma chromatic number of a graph, Graphs Combin., 26:6 (2010) 755–773.

[2] G. Chartrand, F. Okamoto, and P. Zhang, Rainbow trees in graphs and generalized connectivity, Networks, 55:4 (2010) 360–367.

[3] F. Fujie and P. Zhang, *Covering Walks in Graphs*, Springer Briefs in Mathematics, Springer, 2014.

Awards and Prizes:

- The 2008 Kirkman Medal (The Institute of Combinatorics and Its Applications)

Education and Appointments:

2007 Ph.D. in Mathematics, Western Michigan University
2007 Assistant Professor, University of Wisconsin La Crosse
2011 Associate Professor, University of Wisconsin La Crosse
2012 Associate Professor, Nagoya University

Message to Prospective Students:

Graph theory is a relatively new area of mathematics and has increased in popularity, perhaps partly due to the fact that introductory books usually contain many cute figures and interesting real-world applications. It is possible that one can jump in and start studying graph theory without having very deep background, so I welcome those students even if they are new to this field. Of course, however, that does not mean graph theory is easy! It is unlikely that one will be successful without having strong interest and dedication. Being strong in reading and writing would be another requirement; again, you do not have to be perfect from the beginning, but this is a heads-up. For those that want to learn the basics, here are some good books that cover standard topics:

[4] G. Chartrand, L. Lesniak, and P. Zhang, Graphs and Digraphs (CRC Press, 2010).
[5] J.A. Bondy and U.S.R. Murty, Graph Theory (Springer, 2008).

Finding good problems is as essential as becoming familiar with the subject. When one reads literature, remember to ask oneself questions such as how the given concepts can be generalized and what else can be explored.