“Wiener Indices of Graphs with Many Cut-Edges”

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Efficient computation of the Wiener Index, defined as the sum of all pairwise shortest paths in a graph, is of fundamental importance to Graph Theory and Chemistry. While well-known shortest-paths algorithms can be used to compute the index, the resulting algorithms are often inefficient. Here we present a different method to compute the Wiener Index for undirected and unweighted graphs, by taking advantage of cut-edges, biconnected components, and the block-cut tree. Then, using a contribution counting argument, we achieve a new equivalent expression for the Wiener Index. Using this expression, the Wiener Index can be calculated significantly faster than traditional methods, in an algorithm that will be presented by collaborator Albert Jiang. Through the same idea, we also explore the maximum and minimum values of the Wiener Index in graphs with predetermined “pseudo components”.