Convergence of Hitting Times and Commute Distances on Random Geometric Graphs

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The commute distance between two vertices in a graph is the expected time it takes a random walk to travel from the first to the second vertex and back. We study the behavior of the commute distance as the size of the underlying graph increases. We prove that in many random graph models, the commute distance converges to an expression that does not take into account the structure of the graph at all and that is completely meaningless as a distance function on the graph. Consequently, the use of the raw commute distance is strongly discouraged for large graphs and in high dimensions.