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Mutual Percolation of Multiplex Networks with Link Overlaps

SANGCHUL LEE, BYUNGJOON MIN, KYU-MIN LEE, K.-I. GOH, Korea University — Many real-world complex systems operate through multiple layers of distinct interactions and the interplay between them. Most studies on multiplex networks, however, have largely ignored the effect of the link overlap across layers despite the strong empirical evidences for its significance. In this respect here we study the impact of link overlaps on mutual percolation of multiplex networks with two layers (duplex networks). We present the analytic solution based on the generating function approach that explicitly distinguishes the distinctive roles that the overlap- and non-overlap links play in establishing the mutual connectivity. The analytic solution is fully supported by extensive numerical simulations, thus successfully remedies the shortcoming of previously proposed theory by Cellai et al. [arXiv:1307.6359v1]. Our analytical results show that while the overlap links strongly facilitate mutual percolation by making components connected with overlap links yet it is unable to diminish the discontinuous nature of mutual percolation transition. Finally, we discuss the implication of our results to the robustness of duplex networks against link failures.

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