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**The nine neighbor Extrapolated Diffusion method**

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The convergence analysis of the Extrapolated Diffusion (EDF) was developed in [?] and [?] for the weighted torus and mesh graphs, respectively using the set  $\mathcal{N}_1(i)$  of nearest neighbors of a node  $i$  in the graph. In the present work we propose a Diffusion scheme which employs the set  $\mathcal{N}_1(i) \cup \mathcal{N}_2(i)$ , where  $\mathcal{N}_2(i)$  denotes the four neighbors of node  $i$  with path length two (see Figure ??) in order to increase the convergence rate. We study the convergence analysis of the new Diffusion scheme with nine neighbors (NEDF) for weighted torus graphs. In particular, we find closed form formulae for the optimum values of the edge weights and the extrapolation parameter. A 60% increase in the convergence rate of NEDF compared to the conventional EDF method is shown analytically and numerically.