Extending the PC-Tree Algorithm to the Torus

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Abstract: Planar graphs have been well studied and there are many linear-time algorithms for determining if a given graph is planar. In particular, The PC-Tree Algorithm of Shih and Hsu (1999) is a practical planarity algorithm that provides a plane embedding of the given graph if it is planar and a Kuratowski subdivision otherwise. The torus and toroidal graphs are less understood, so we discuss extending the PC-Tree Algorithm to a polynomial-time toroidality algorithm. As a proof-of-concept, we show how to accomplish this for $K_{3,3}$-free graphs. We will also consider connections to other areas such as Graph Minors Theory and the Kuratowski Cover Number. Possible applications of this research in Computer Science and Chemistry will be discussed.