基于区间拓扑分析的参数曲面保拓扑的求交（程进三）

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Computing the intersection between two parametric surfaces (SSI) is one of the most fundamental problems in geometric and solid modeling. Maintaining the SSI topology is critical to its computation robustness. We propose a topology-driven hybrid symbolic-numeric framework to approximate rational parametric surface-surface intersection (SSI) based on a concept of interval algebraic topology analysis (IATA), which configures within a 4D interval box the SSI topology. We map the SSI topology to an algebraic system's solutions within the framework, classify and enumerate all topological cases as a mixture of four fundamental cases (or their specific sub-cases). Various complicated topological situations are covered, such as cusp points or curves, tangent points (isolated or not) or curves, tiny loops, self-intersections, or their mixtures. The theoretical formulation is also implemented numerically using advanced real solution isolation techniques, and computed within a topology-driven framework which maximally utilizes the advantages of the topology maintenance of algebraic analysis, the robustness of iterative subdivision, and the efficiency of forward marching. The approach demonstrates improved robustness under benchmark topological cases when compared with available open-source and commercial solutions, including IRIT, SISL, and Parasolid.

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