A NOVEL ITERATIVE PREDICTOR-CORRECTOR APPROACH FOR MODELING COULOMB FRICTION IN REAL-TIME SURGICAL SIMULATIONS

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ABSTRACT

Modeling frictional effects is one of the important aspects of building realistic physics-based real-time surgical simulations. In this work we present a novel iterative predictor-corrector (IPC) approach to simulate Coulomb friction during interactions with deformable objects. The proposed IPC method works within the purview of the implicit mixed linear complementarity problem (MLCP) formulation of collision response. IPC determines the potential direction of the frictional forces from contact by leveraging the monotonic convergence of an iterative MLCP solver. We then categorize the contacts into *static* and *kinetic* frictional states based on the approximate force estimations. Linear projection constraints (LPCs) are used to enforce 'stiction' for contacts in static friction. We propose a *modified iterative constraint anticipation* (MICA) approach that can resolve the LPCs while solving the MLCP. We further extend IPC to the case of contacts between two deformable objects. In this case the LPCs are replaced by a linear constraint involving two or more contact nodes. IPC can model both asymmetric and heterogeneous type anisotropic friction models. Our method also requires low memory and is tunable between accuracy and speed. We demonstrate IPC with various examples relevant to real-time applications.