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SIMULATION OF SURGICAL CUTTING USING A PROGRESSIVE CUTTING SCHEME AND EXTENDED FINITE ELEMENT METHOD

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Accuracy and speed are two of the most important problems in the real-time Finite Element Method (FEM)-based simulations of surgical cutting [1][2]. While the latter can be gradually eased through GPU-based acceleration[3][4], the former hasn't been properly addressed even until recently. To enable realistic and accurate simulation, the cutting line should follow the exact movement of the user-controlled virtual scalpel in real-time. However problems in the collision detection and the cutting scheme can easily result a wrong response such as 1) Elements have been cutted before virtual scalpel's arrival, 2) an obvious lag between the virtual scalpel and the model modification. A progressive cutting scheme was proposed in recent years to minimise the lag problem[5]. But it is based on the mesh subdivision in a standard FEM approach. Extended Finite Element Method (XFEM) which has the advantage of modeling arbitrary cuts without modifying the underlying mesh is favoured in this work over the standard FEM [6][7][8]. Along with a carefully-designed collision detection method, this work seeks to simulate surgical cutting without any ill response or lag and improve the overall cutting accuracy. Experiments based on the (Simulation Open Framework Architecture) Sofa package [9] have demonstrated promising results using the proposed method

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