

# **Visual Simulation in Virtual Abdominal Surgery**

by

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**Master of Science in Software Engineering**

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**Faculty of Science and Technology  
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by

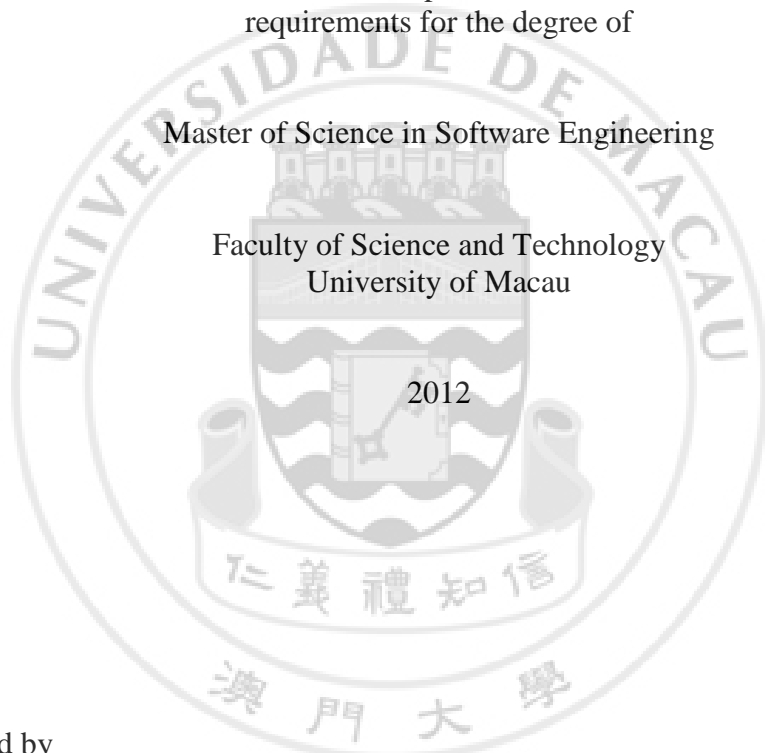
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Approved by \_\_\_\_\_  
Supervisor

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Abstract

VISUAL SIMULATION IN VIRTUAL ABDOMINAL  
SURGERY

by Huang Jingye

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Software Engineering

Virtual surgical simulation is getting more and more interest. As a good complement to traditional surgical training, it provides a safe, economical and potentially effective way in medical training in which the surgeons can control the haptic devices to interact with the virtual organs, acquire the tissue pathological information from some phenomena like surface rendering and bleeding.

The visual effect is so crucial to the pathology that we should pay more attention when developing the simulation system. This thesis focuses on the visual simulation, especially investigating the novel methods on surface rendering and bleeding simulation.

For the surface rendering, Perlin noise was used to generate an organ surface-like texture, which can effectively map to the surface with complex topology. For a viscous surface, the specular highlight is a little bit scattered. Different Perlin noise functions are presented to produce this special specular highlight.

For the bleeding simulation, a hybrid fluid simulation method is presented which combines the grid-based method and smoothed particle hydrodynamics (SPH) method to simulate various bleeding phenomena during abdominal surgical procedures. The two-dimensional grid-based method was utilized to simulate the diffusion of a small amount of blood on the organ surface. And then the SPH method was integrated to simulate the blood droplets, which enhanced the reality of the entire simulation.

Keyword: surgical simulation; surface rendering; fluid simulation; bleeding



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