# Don't shoot them! Heal them!

## Using Game Engines as a Basis for Surgical Simulators

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## Abstract

Virtual surgery training has become an essential tool in medical education. Unfortunately, commercial simulators are very expensive and mainly focus on individual training instead of teamwork.

Game engines offer unique advantages for the inexpensive creation of interactive and collaborative environments. We show that it is possible to easily design multi-user scenarios with custom medical models.

Our results will help to develop low cost surgical simulators that will improve health care outcomes for smaller hospitals or in regions which do not have access to advanced training tools.


Game Controller
(Photo: Logitech)

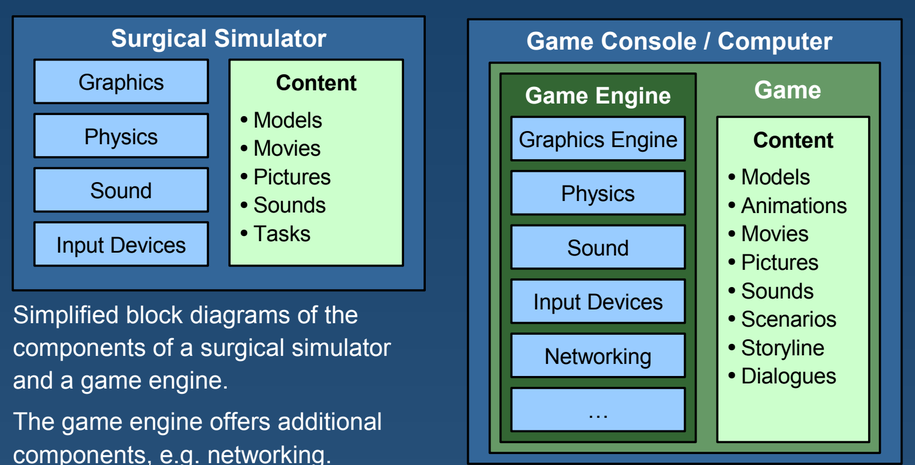
## Introduction

Pilots are trained in simulators before they control a real plane for the first time. Captains have simulators for all sizes and kinds of ships. In the recent years, surgeons, too, have recognised the need for simulation before they operate on real patients [1].

The major problem with all surgical simulators are their high costs. Small hospitals or facilities in third world countries cannot afford to obtain them. Surgeons often have to travel far to training centres to be able to train at all. *When* they get the opportunity for training, it will mainly improve their technical skills, but not the skills necessary for working as part of a team.

The design of a surgical simulator is similar to that of a game engine, the "heart" of modern computer games. Compare a computer game to a car: The motor represents the game engine and the exterior represents the game content. Changing the content results in a totally different game, just as a different chassis turns a car into a transporter – still with the same motor powering it.

If it is possible to buy an arbitrary computer game and to exchange the content by a medical simulation, then the result is a training device that can be used nearly everywhere, at low costs, on a multitude of platforms (e.g. PC, XBox™, Playstation™), and in cooperation with other users connected by a network.




Simplified block diagrams of the components of a surgical simulator and a game engine.

The game engine offers additional components, e.g. networking.

## Methods

1) Analysis of a list of game engines [2] and identification of suitable candidates that are commercially available, inexpensive, stable, and offer means of editing the game content.
2) Creation of custom scenarios for testing the graphical and the physical simulation capabilities (e.g. animation, joints, soft tissue, deformation).
3) Test of the collaborative manipulation of physical objects by several users over network.
4) Exploration of the possibilities of extension, e.g. additional physical simulation models.

## Results

In our current state of research, we have evaluated 278 game engines. Three of the most promising candidates were examined in detail. We discovered that all of them are at least able to play back pre-recorded animations (e.g. heartbeat, cutting of tissue). One engine additionally allowed multiple users the full interaction with simulated physical objects.

The number of possible surgical scenarios is currently limited by the available physical simulation models. Nevertheless, game engines can be extended by additional models.

We also discovered methods and principles that allow for a fully automatised inclusion of custom medical data into the simulation.


A preliminary scenario created with the "Source Engine," one of the three engines we examined in detail. The skeleton model can be viewed and moved by the two users who are connected by network.

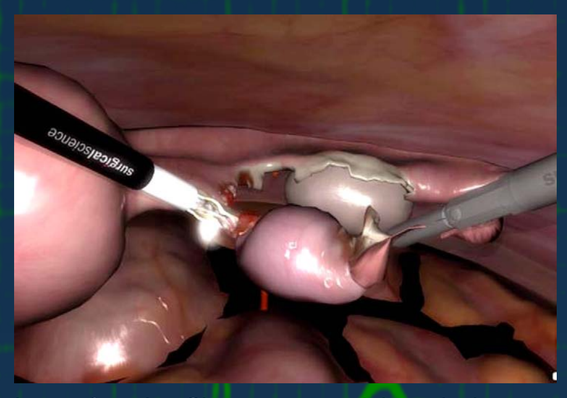



Image from LapSim, a commercial surgical simulator. It shows a salpingectomy, the removal of a fallopian tube.
(Image: Surgical Science)

## Conclusion

Our preliminary results are promising and open up new and exciting research opportunities.

The networking capabilities of game engines allow the cooperation of multiple users who all can choose freely when, where and what they want to train. In addition, a supervisor or teacher can monitor and comment on their performance as well as increase or decrease the difficulty.

The fact that game engines are inexpensive and run on a variety of platforms makes them ideal for use in smaller hospitals and medical facilities in third world countries.

At least two new engines with improved graphical and physical simulation capabilities are going to be published during the end of this year. We will analyse them in detail and also develop additional simulation scenarios and tools for the automatised inclusion of patient specific medical data.

Surgical team performing an endoscopic removal of colon cancer. (Photo: University of Cincinnati)

## References

[1] D. M. Gaba, "The future vision of simulation in health care," *Quality and Safety in Health Care*, vol. 13, Suppl 1, pp. i2–i10, Oct. 2004.

[2] DevMaster.net. (2007) *3D Game Engines Database.*