

## Surgical Simulation and Planning

The Biomedical Imaging team at the Australian e-Health Research Centre is currently researching and developing high fidelity tools to assist with training and planning for surgical procedures. Off-patient training tools can reduce the risk that training presents to patients and surgical planning tools assist surgeons to plan successful, effective surgeries.

Research includes development of highly realistic, virtual surgical training environments which include haptic (touch) integration of real surgical instruments. Surgical planning research is focussed on analysis of patient image data to provide quantitative data to assist with surgical planning.

### CSIRO Colonoscopy Simulator

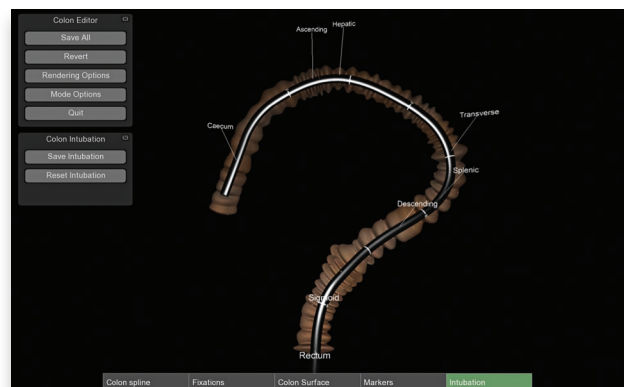
Current figures show that over 80 Australians die weekly from cancer of the bowel or rectum (colorectal cancer). Colonoscopy is considered the gold standard for detection (and treatment) of early stage colorectal cancer. Unfortunately it is a difficult procedure to master, requiring up to 1000 cases to reach an expert level. Literature indicates that the existing computer based colonoscopy training simulators lack fidelity in haptic, visual and anatomical realism as well as case complexity.

Our research aims to address these shortcomings through research and development of a simulator which integrates a high fidelity, physically accurate virtual environment with a haptic device capable of rendering realistic force feedback via a modified surgical endoscope.

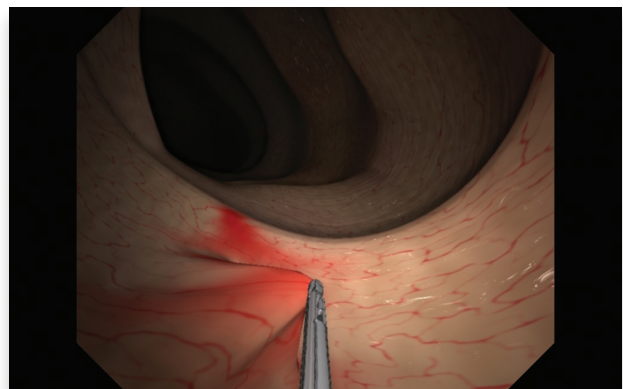
The Australian e-Health Research Centre is working with the Queensland Health Skills Development Centre and the University of Queensland to develop the Fundamentals of Colonoscopy training curriculum. The crucial role of the colonoscopy simulator in this curriculum, combined with an exclusive license for one of the global leaders in surgical simulation, Surgical Science Sweden, to bring the simulator to market, should see the CSIRO Colonoscopy Simulator have a profound impact on colonoscopy training in Australia in the coming years.



*The virtual simulation interacts with a modified clinical endoscope via a high fidelity haptic device.*



*The CSIRO Colonoscopy Simulator Editor allows developers to design case complexity tailored to the required trainee level.*



*The CSIRO Colonoscopy Simulator provides physicians with a highly realistic environment where complex techniques can be taught and practiced with no risk to patients.*

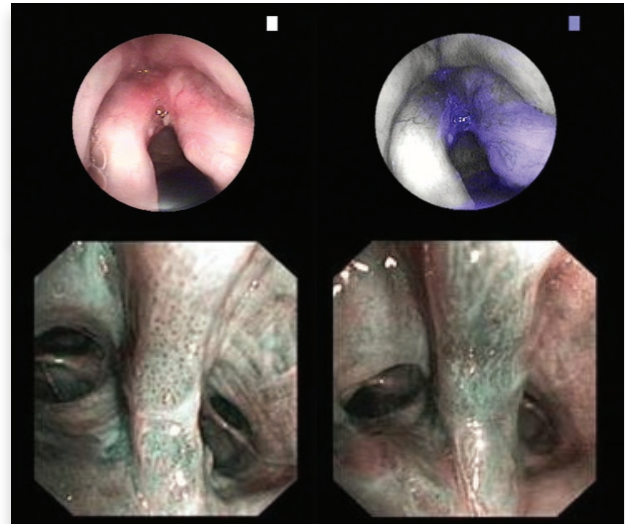
## CSIRO Bronchoscopy Simulator

Recent developments in novel imaging techniques applied in bronchoscopy are being pioneered by surgeons in the Royal Brisbane and Women's Hospital. Existing simulators do not incorporate these new techniques in their training programmes. Therefore the Australian e-Health Research Centre is collaborating with these surgeons to develop an innovative bronchoscopy simulator based on the framework that was developed for the colonoscopy simulator. This bronchoscopy simulator will allow trainees to become familiar with these new imaging techniques in a safe off-patient environment.

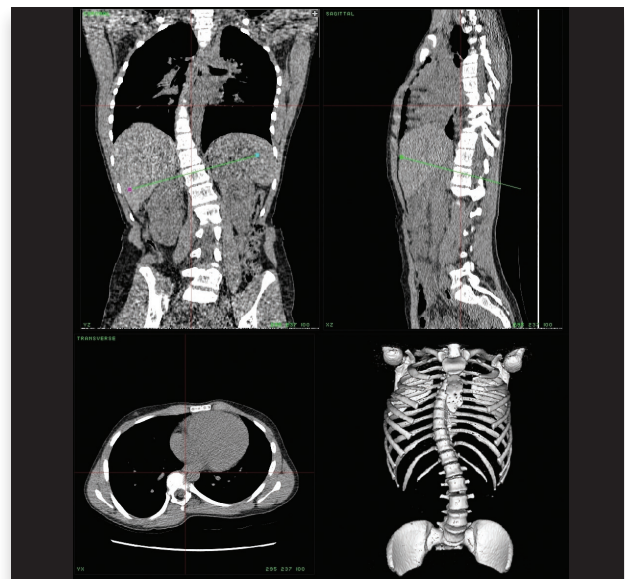
## Pre-operative Planning – Scoliosis Correction

In collaboration with the Queensland University of Technology's Paediatric Spine Research Group, a scoliosis (sideways curved spine) pre-operative planning tool is under development. The application supports high fidelity interactive volume rendering of patient CT data and provides researchers with the quantitative data necessary for building complex, patient specific models. These models are used to predict the forces and stresses on the spine and correction rod that will result from proposed surgical corrections.

*Virtual surgical training systems have the potential to significantly reduce the cost and risk of surgical training, while providing quantitative assessment of surgical skills. Novel pre-operative surgical planning tools assist surgeons in making informed decisions and result in safer, cheaper surgical interventions. The Biomedical Imaging team at the Australian e-Health Research Centre is committed to filling gaps in existing surgical training and pre-operative planning processes.*



*White light and autofluorescence imaging showing tissue changes in the right vocal cord only visible under autofluorescence (top). Narrow band imaging appearance pre and post diathermy, showing a lack of dot pattern and thin parallel running capillaries post diathermy (bottom).*



*Patient CT images are visualised and quantitatively analysed to provide preoperative surgical planning information required for scoliosis correction surgery.*