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Training and guiding surgeons with numerical simulation

Abstract:

In this presentation, we will see how recent results in the field of real-time numerical simulation have the potential to change the way that doctors train, plan complex operations or perform interventions.

In the area of surgical training, I will present the challenges faced by more and more clinicians, due to increasing training difficulties and the rapid introduction of new technologies that require regular training. In particular, I will talk about a project carried out in partnership with the American foundation HelpMeSee, which aims to train thousands of surgeons in new cataract surgery to reduce blindness in developing countries. This very large-scale humanitarian action is based, on the one hand, on the emergence of a new surgical technique adapted to the constraints of the target countries and, on the other hand, on the use of very advanced simulation techniques to train a large number of surgeons in this new approach.

This research project, which has become a development project, has the potential to change the way in which the role of the virtual in medical training is considered today.

The role of numerical simulations in medicine can also extend to the field of operating room assistance, which can be provided by augmented reality techniques. The general principle is to combine, in real time, a virtual model with an image of the operating field. This makes it possible, for example, to visualize the internal structures of an organ (tumors or arteries, for example) that are normally invisible to the surgeon. As a result, it is possible to better control the surgical procedure, or even to plan the operation. Yet, to achieve these goals, many challenges must be met. In particular, anatomically and biomechanically realistic numerical models of the patient must be developed, while remaining compatible with real-time computing constraints. In the end augmented reality allows many other things and can be applied to surgical robotics for instance.

Some references

- <https://helpmeseesee.org>
- <https://hal.inria.fr/hal-01160297>
- <https://link.springer.com/article/10.1007/s11605-020-04519-4>
- <https://hal.inria.fr/hal-02144487>