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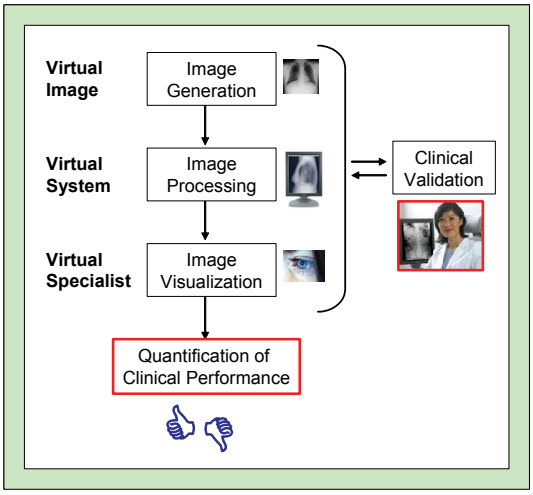
MEVIC

Medical Virtual Imaging Chain

Image Quality

The goal of the MEVIC project is to develop a software simulation platform which can be used to reliably determine the clinical performance of a medical system. The platform will be used to simulate the entire medical image chain: from image generation, to processing, to visualization. Using the simulations, it will be possible to tune the physical parameters of medical devices from the standpoint of not only technical measurements, but more importantly, human perception. In other words, medical devices will be optimized in terms of their performance for specific clinically relevant tasks.



The simulation framework will be applied to specific clinical domains, for example digital mammography, nuclear medicine, and computed tomography.

Why?

One of the biggest challenges in the medical imaging domain is to accurately and reliably quantify and then optimize the clinical performance of their acquisition devices, image processing algorithms and displays. This project seeks to solve two major problems that many companies and academic institutions are struggling with:

1) As of today, it still is a huge problem to obtain medical images and datasets for validating developments that are done in the medical imaging area.
2) Reliably determining the clinical performance of a medical system requires a time consuming and expensive clinical trial.

There are two main reasons why this is such a problem. First of all: people developing the technology are typically engineers with no or only limited clinical knowledge. Therefore, they will normally use "engineering metrics" to quantify performance, rather than actually determining the clinical performance of the technology. It is well known that there is often little correlation between engineering metrics and clinical performance.
An alternative solution is of course to do a clinical trial. But unfortunately, performing clinical studies is an extremely expensive and time consuming activity. Even if the money and time is available, then still there is a huge problem in finding a sufficiently large number of medical images that can be used for the clinical trial. Not only do patient privacy regulations make it very difficult to obtain medical images, but in addition these medical images often do not represent a realistic sample of the population, and therefore there is doubt about the real value of the clinical trial.

Scientific description of the research

The solution that this project consortium will develop consists of three steps. First of all, algorithms will be developed that can produce realistic medical images, eventually including specific (simulated) lesions, with known ground truth. This will solve the difficulty of obtaining real medical images.

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A second step will consist of accurate simulation models of the medical devices that we want to evaluate. Examples of such devices can be: medical displays and visualization software, acquisition devices such as scanners and image processing algorithms. Having simulation models available has the advantage that it is not anymore necessary to develop multiple prototypes of medical systems: this can be replaced by software simulations.

The third and final step is the development of mathematical observer models. It has been shown that such mathematical observer models have a very good correlation with the decision process of real radiologists. In other words: such observer models could replace clinical trials. At the moment there are still many limitations to these mathematical observer models and it is the goal of this project to make these models more accurate and reliable. The unique combination of these three steps will give the project consortium the possibility to perform software simulations that can replace an entire clinical trial, including the image generation, device prototyping and the actual observer study with radiologists.

Naturally, the developed algorithms and models are only valuable if we can prove that they accurately resemble reality and will give the same results as real clinical trials. Therefore, a very important step in this project will be to compare the developed algorithms and software with real clinical experiments. For this purpose, a portion of the project will be devoted to validating the methods with observer studies performed by radiologists.

Valorization of the project

By means of the framework that will be developed in this project, the consortium will be able to much more easily measure the clinical performance of various medical devices. It will be possible to simulate clinical trials, for example to compare different technical alternatives, without the need to make actual prototypes. It is obvious that this will result into higher quality products that will improve quality of healthcare. Furthermore, the ability to accurately predict the results of human clinical trials can hopefully improve and simplify the regulatory approval process. Access to healthcare will also be improved, through quicker time-to-market and reduced research and development costs.

The benefits of the MEVIC project extend far beyond the borders of Flanders and Belgium: society as a whole will benefit from reduced healthcare costs – through more cost effective research and development processes, and an increased quality of healthcare – through higher quality medical devices.

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