

Virtual Gastrointestinal Tract

VIGOR++ aims to improve detection and accurate assessment of Crohn's disease, an autoimmune condition with 700,000 diagnosed cases across Europe. By combining advances in image analysis, modelling and interactive visualisation VIGOR++ will create a personalised model of the gastrointestinal tract reducing the need for frequent and often invasive examinations.

Objectives of the Project

Millions of European citizen suffer from diseases of the intestines with 700,000 cases diagnosed as the autoimmune condition, Crohn's disease. This chronic condition is characterised by alternating periods of increased and reduced disease activity. It is therefore important to regularly assess the stage of the disease in order to adjust the treatment accordingly. Frequent and sometimes invasive examinations are necessary to monitor response.

VIGOR++ aims to replace such examinations by combining advances in image analysis, modelling and interactive visualisation to create a personalised model of the gastrointestinal (GI) tract. The ultimate goal is to accurately predict the colonoscopy and histopathology data and the associated indices of disease severity.

Objectives include:

- Adapt existing image analysis algorithms to accurately measure descriptive properties of GI wall tissue.
- Create patient specific imaging tools to quantitatively assess the status of Crohn's disease.
- Develop visualisations of all aspects of the GI tract model.
- Conduct rigorous testing to ensure a clinically usable system.
- Establish a new care pathway for accurate, non-invasive and cost-effective examination of the GI tract for Crohn's disease.
- Disseminate knowledge and ICT tools by actively engaging fellow academic disciplines, industry and inflammatory bowel disease patient associations across Europe.



Project Description

The VIGOR++ project aims to create a personalised GI tract model, which facilitates improved detection of Crohn's disease and drives an index of Crohn's disease severity. The model would enable a non-invasive procedure for estimating the disease index.

Multiscale data acquisition including laboratory, MRI, colonoscopy and microscopy (histopathology) data from Crohn's disease patients will be used in the development of accurate prediction models as integrated ICT tools. These tools include a normal representation of the GI tract that facilitates detection of abnormalities, ability to grade disease severity, and influence clinical disease management.

By adopting a software as a service (SaaS) platform, VIGOR++ aims to make its tools accessible on any browser

VIGOR++ will combine proven image analysis techniques to identify regions of interest and register the MR images to compensate for patient movement. In addition, descriptive properties of Crohn's disease activity will be measured in images. The features obtained will be the basis of the modelling and classification tasks.

Pattern recognition techniques will be applied to detect and rate abnormalities, so that a combined and quantitative, clinical disease severity index can be accurately established.

A visualisation software toolbox will be designed to enable interactive visualisation of GI wall tissue properties. It will feature techniques for concurrent visualisation of the multiscale clinical patient data as well as the properties measured by image analysis and classification.

The system will be rigorously tested throughout the project to ensure both accuracy and usability in a clinical setting.

To ensure validation, the clinical benefit will be demonstrated in a study in which the tools' ability to predict Crohn's disease is assessed. A preliminary study will also be performed that is designed to demonstrate the effect of therapy.

SCENARIO

Patient X, a long time sufferer of Crohn's disease, attended the clinic due to a flare-up in her condition. A new MRI scan was enough to update her personal GI tract model. The doctor was then able to see the cause and alter her medication to manage the condition better. The speed and ease of the diagnosis and quick response of treatment managed by the VIGOR++ tools came as a relief to her. She had heard how in the past she would have been faced with an invasive colonoscopy and treatment based on only partial information.

Expected Results & Impacts

VIGOR++ will deliver tools that offer Crohn's disease sufferers the prospect of a non-invasive, radiation free, low-risk and accurate diagnostic environment. The procedure will result in disease management that is less disruptive to patients' day-to-day lives and empower them via simple portals to play an active role in their care.

Benefits for clinicians include:

- Increased efficiency of diagnosis and integration with treatment planning
- Ability to assess the disease progress and predict potential complications in a non-invasive way
- Minimisation of the need for optical colonoscopy particularly for patients unable to tolerate sedation or bowel preparation
- Automatic identification of results outside acceptable ranges
- Support for shared decision making with patients
- Quantification of medication efficiency

Economic benefits include:

- Reductions in patient time off work during their most productive years when the disease is most prevalent
- Reduced diagnosis and disease management cost through higher throughput and reduced hospital stays
- Improved return on investment for technology such as MRI scanners

The results will benefit national health systems through meeting targets and private health insurers through direct cost savings.

The tools should also help pharmaceutical companies carry out more efficient and less costly clinical trials by providing accurate, quantitative descriptors of therapy effect.



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Project co-ordinator:
Delft University of Technology (The Netherlands)

Contact person:
Frans M. Vos
Tel: +31 15 278 7133
Email: f.m.vos@tudelft.nl
Website: www.vigorpp.eu

Partners:

- Delft University of Technology (Netherlands)
- Academic Medical Centre, University of Amsterdam (Netherlands)
- Biotronics3D Ltd (UK)
- Swiss Federal Institute of Technology Zurich (Switzerland)
- University College London Hospitals (UK)
- Vodera Ltd (UK)
- Zuse Institute Berlin (Germany)

Timetable: from February 2011 to January 2014

Total cost: € 3,925,530

EC funding: € 2,990,000

Instrument: STREP

Project Identifier: FP7-ICT-2009-6-270379

KEYWORDS

Non-invasive systems, Medical imaging processing and analysis, Visualisation, In silico simulation, Clinical applications, Personalised health, Software as a service, Virtual physiological human.