RASimAs newsletter

30th April 2014

Issue 1

Editorial

The RASimAs project, standing for Regional Anaesthesia Simulator and Assistant, has been launched with a great success by the 14 academic, clinical and industrial partners gathered for this occasion in November 2013 in Aachen (Germany). With a real enthusiasm, the first lines of the simulator and assistant have been drawn, motivated by our objective to provide a safer environment for the patient while saving costs of healthcare. After six months, significant progress towards our objective have already been achieved by the consortium. As an illustration

Content

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 610425.

of the stimulating atmosphere in the consortium, a workshop gathering most of the partners has already been organised during three consecutive days earlier this month, strengthening the cooperation between the partners. I am delighted to see our project already presented to the scientific community through conferences and publications, but also to the general public, which can follow our progress though the website, press releases and on the social networks.

Prof. Thomas Deserno

Project summary

The aim of this ambitious project is to gather European experts from very diverse fields, from computer sciences to anaesthesiology, to bring an innovative tool in the hands of the medical doctors to perform safer regional anaesthesia for the patient at reduced cost for the society. Regional anaesthesia consists in injecting anaesthetic in the vicinity of a nerve to anaesthetise a whole body region. A lack of training options is currently noted by anaesthesiologists and this project aims at filling this gap. For that purpose, a virtual reality simulator and assistant will be developed, providing an innovative way for medical doctors to train extensively on virtual patients and to be assisted by additional patient-specific information during the procedure.

"Patient-specific training of regional anaesthesia provides a safer environment for the patients while saving costs of health care." (Prof. Rolf Rossaint, Uniklinik RWTH Aachen, Germany)

The project in numbers

3,3…millions euros funded by the EU

8…workpackages

10…European countries involved

13…milestones

14…academic, industrial and clinical partners

36…months duration

39…tasks

45…deliverables

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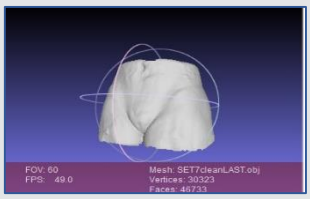
Words from the partners

Department of Medical Informatics, Uniklinik RWTH Aachen, Germany



Simulating and assisting the physicians for regional anaesthesia in a virtual reality platform require virtual patients. For this purpose, the Department of Medical Informatics of the Uniklinik RWTH Aachen is focusing on the building of deformable anatomical models able to represent the morphology of a wide range of hypothetical patients. The various morphologies are extracted from medical images, typically MRI or Computer Tomography and a reference patient is deformed towards them in order to complement the missing tissues. The variability of the tissue shapes across the population will be characterised. Our aim will be to link the main deformation modes to the patient characteristics such as weight, age or height.

Department of Anaesthesiology, Uniklinik RWTH Aachen, Germany

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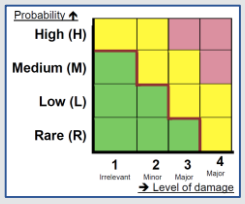
CTC-A, Uniklinik RWTH Aachen, Germany



Success of projects is threatened by a lot of different risks concerning deviations from standards. The occurrence of errors cannot be excluded completely. Design of robust and lean processes is not sufficient to ensure project success. A prospective and proactive error management is needed as additional project assurance. For RASimAs the CTC-A has identified, described and classified potential errors (according to probability of occurrence and level of damage) that bear risks concerning reduction of data quality and/or safety and welfare of study subjects of the planned trials. Additionally a corresponding action plan has been created and every identified potential error is coupled to individual preventive and corrective measures within a project specific quality assurance plan.

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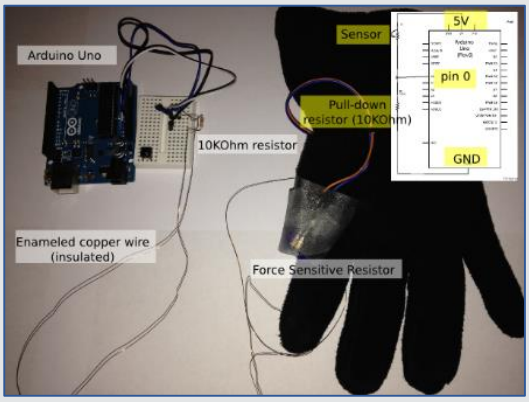
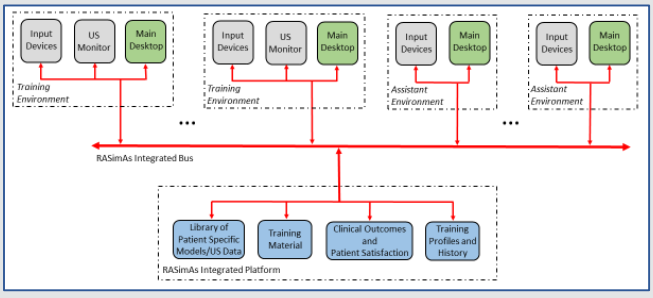
Bangor University, UK



When haptic devices are used as part of a medical training simulator, it is important to determine the range of forces that are experienced when carrying out the procedure on a patient so that they can be accurately replicated. Such information is difficult to find in the literature. The Bangor team have therefore designed and built a custom glove that uses a force sensitive resistor sown onto the thumb, and driven by an Ardino Uno board. The glove was trialled at a RASimAS technical meeting at Strasbourg in April 2014 during an animal study. The force data obtained for needle insertion will be useful in several work packages as we model tool interaction and physiology responses. The glove can also be used later in the project for calibration of simulator components.

FORTH, Greece



The Foundation for Research and Technology is the leader of the "Technological Environment" of the project, related to the system specifications, reference architecture, information storage and image processing library.

FORTH, based on the system specifications and in close collaboration with the rest of the technical partners and domain experts, has already designed the core architectural plan and defined its main components. Primarily, FORTH is responsible for the orchestration of the training environments located at the hospitals with a central system (server) transmitting information to each other. This information may be trainees' electronic records (profiles and histories), performance metrics statistics, login authentication credentials, patient specific models, software updates etc. FORTH is also responsible for the data storage (simulation models, images) and the integration of the simulation models consisting the simulator platform.

FORTH has recently submitted the "Reference Architecture" of the simulator and assistant platforms due by the end of April 2014. FORTH has also initiated the implementation of the "Information Storage" task (due end of July) as the main architectural component for the management of the data that used and/or produced in the RASimAs platform.

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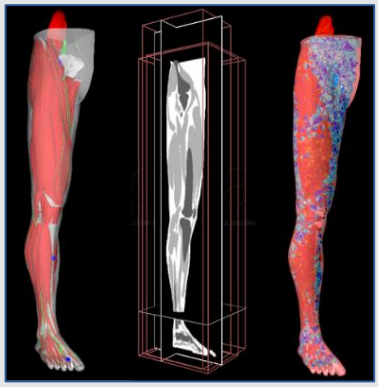
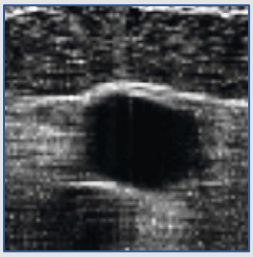
INRIA, France



Our work has been centred around the modelling and simulation of a complete leg model using a process that can be applied to patient-specific data. In this process we are able to generate a non-homogeneous volumetric mesh from a segmented medical image. The resulting mesh captures the different structures of the limb (bones, muscles, skin) so that appropriate tissue properties can be assigned to each region. A real-time finite element method is then used to compute the deformation of the leg. This step is a major requirement for modelling the interaction with a needle, or for simulating the effect of muscle contraction during electrical stimulation of the nerve.

Virtual Reality Centre, RWTH Aachen, Germany



Brightness modulation (B-Mode) ultrasound (US) images are used to visualize internal body structures during regional anesthesia. US imaging allows direct and immediate visualization, nevertheless physicians require training and experience to properly interpret images to find and identify the structures of interest. Therefore, the simulator which is developed in this project will include a US simulation mimicking the behavior of the US wave within tissue.

The method should be applicable to diverse scenarios without reacquired data, it should be interactive and furthermore reflect tissue deformations, for example due to needle insertion and movement. To meet these challenges, we currently follow an approach based on geometrical acoustics to model the US wave as rays. With this approach we are able to simulate a large range of artifacts and phenomena, common in US images, namely, reflection, attenuation, acoustic shadows, enhancement, reverberation, speckles and blurriness.

EU Project Management Office, RWTH Aachen, Germany

The objective of the EU Project Management Office from the RWTH Aachen University RWTH-EUPM, represented by Christine Kempchen, is the administrative management of the RASimAs project. As RASimAs is funded from the European Union´s Seventh Framework Programme for research, technological development and demonstration, it is necessary to keep an eye on meeting the financial and administrative guidelines published by the European Commission. These activities are carried out by the RWTH Project Management Office in order to enable the scientists within the consortium to concentrate on their scientific work and to relieve them from time-consuming paper

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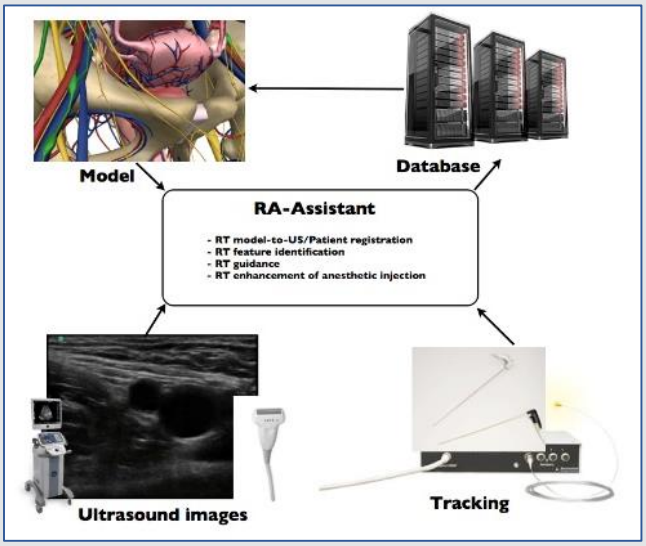
work. To our main task belong the financial check of expenses (personnel costs and invoices occurred during the project period), the organisation of consortium meetings, supporting the Coordinator in the preparation of reports to the Commission, answering any administrative questions from the consortium partners, prepare the communication towards the Project Officer settled in Brussels. Providing consultancy services for researchers and assisting UKA- and RWTH-institutes through the entire project lifecycle belongs to the daily work of the EU Project Management Office of RWTH Aachen With nearly 120 signed FP7 Grant Agreements in "Cooperation", 15% are coordinated, RWTH-EUPM has extensive experience with the contractual, financial and administrative procedures of EU-projects.

Sintef, Norway



SINTEF's overall objective in the RASimAs consortium is to build a regional anesthesia (RA) assistant that will be validated in clinical trials conducted by the clinical partners within the project. The RA-Assistant should be a procedural assistant that addresses the main challenges a physician is faced with when performing an ultrasound-guided peripheral nerve block today: 1) acquisition and interpretation of real-time 2D ultrasound images, 2) placement of the needle close to the target nerve in a safe manner and 3) verification that the anesthetics injected spread around the target nerve. The main tasks so far have been to understand the clinical challenges involved in the procedure, investigate state-of-the art solutions, provide feedback to the clinical needs envisioned by the clinical partners, suggest technological solutions to these needs and find the appropriate architecture and design to implement our ideas. In order to make the RA-Assistant a reality we need an anatomical model of the relevant anatomy, real-time digital access to the ultrasound images, and both the ultrasound probe and the needle must be tracked. The main components that need to be developed are as follows: real-time model to ultrasound / patient registration, real-time feature identification in the ultrasound images, real-time guidance of the needle to the target and real-time enhancement of the anesthetic injection.

SenseGraphics, Sweden

SenseGraphics has dedicated until now most of its resources to the joint effort to define the "Technological Environment" and to some extent also the "RASimAs components".

Based on the report on the User Specification, SenseGraphics was the main contributor to the first proposals on technical solutions for the

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RASimAs hardware development platform. The proposals were delivered to the project as technical design concepts based on a brain storming activity and using the companies experience in developing medical simulators involving haptic technology.

SenseGraphics has set up dedicated servers to host the software development environment for the RASimAs project and also performed a 2 days Work Shop/Training Course (Strasbourg April) in using SenseGraphics H3DAPI software development platform.

During the latter part of the first project period, SenseGraphics employed a new software development engineer that will be the main SenseGraphics contributor to the project.

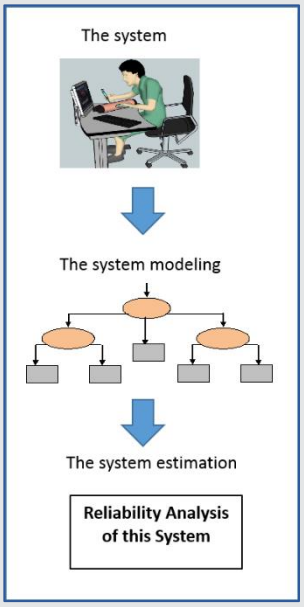
SenseGraphics has so far involved 4 people in the RASimAs project.

University College Cork, Ireland

RASimAS collaborators at University College Cork (UCC), in conjunction with clinical collaborators from Uniklinik Aachen and Katholieke Universiteit Leuven and supported by RWTH, have delivered system specifications for both the simulator and assistant devices. The system specifications are based on defined user needs in: (1) teaching and learning peripheral nerve block; and (2) in the clinical performance of peripheral nerve block. These user needs have informed technical collaborators as to the necessary functionality within RASimAS, and provided a framework from which solutions will be derived.

Future work which will be carried out on campus at UCC by the Technology Enhanced Learning faculty of the ASSERT for Health research group will include procedure characterisation studies for commonly performed peripheral nerve blocks. In tandem with these characterisation studies, assessment tools and associated proficiency based metrics will be defined for key components of the peripheral nerve block procedure. It is intended that the outputs from these studies at UCC will inform the subsequent development of the regional anaesthesia simulator, and add to the validity of the device design.

Univerzity of Zilina, Slovakia



The reliability analysis is principal characteristic of each modern system. One of the principal areas of investigation of UNIZA team is reliability analysis. This investigation has the following goals:

- The development of methods for reliability analysis of (sub-) system in the project;

- The investigation of input and output data reliability;

- The analysis of quality management support for Clinical trial conduction.

The implementation of the project RASimAs causes the development of new method for the

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reliability analysis. The principal characteristics of this method is modelling the investigated system by the decision trees that allow linking the states of the system and its components.

University Rey Juan Carlos, Spain

During the first 6 months of the project, URJC has focused its main research activities on the subject posing, in order to allow the physicians to set the patient in the desired pose in the virtual environment. More precisely, this tasks will transform the anatomical model, provided by our partners in RASimAs, into the final pose required for a specific Regional Anesthesia procedure.

We considered two approaches: a geometrical approach and a physically based approach. On one hand, the geometrical approach is less dependent on other tasks, less computationally expensive and easier to develop. On the other hand, its main drawback is its lack of a continuum mechanical background. The following table compares both alternatives:

	Geometrical approach	Physically based approach
Computational Load	Low	High (depends on the mechanical model use)
Takes into account the mechanical properties of each tissue	No	Yes
It can simulate no linear materials and isotropic behaviors	Difficult	Yes (increasing the computational cost)
Data needs (dependencies with other tasks)	Low	High (a proper mechanical description of the tissue is needed)
Availability of the data needed	Medium high	Low (the final results are highly dependent on data quality)
Stability issues	No	Yes
Interactivity	High	Low
Quality	Probably, good enough for the project	Probably better, highly dependent on the mechanical model
Data adapted to the new pose	Just the anatomical model is adapted	The mechanical properties and the volumetric mesh (among other properties and 3D models) can be adapted to the new rest pose

We are currently developing two prototypes to study the feasibility of both alternatives.

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Project meetings

Kickoff meeting, 14th and 15th November 2013, Aachen, Germany

The project has been launched with the presence of all the partners gathered at this occasion in Aachen, Germany. Each partners have presented their institutions and involvement in the project while avid discussions already started to characterise the need for the simulator and the assistant. A joint dinner has been enjoyed by all the participants in one of the traditional brewery of the medieval city.

Technical meeting, 9th to 11th April 2014, Strasbourg, France

Nine out of the fourteen partners met for a technical meeting in Strasbourg (France) earlier in the month. The objective has been to define in a joint agreement the technical characteristics of the future platform and to set up the technical basis for its development. The three days were very successful and the participants had also the opportunity to test the practise of regional anaesthesia on animals.

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Upcoming events

German congress of Anaesthesiology

Leipzig, Germany, 8th to 10th May 2014

Participation of the Department of Anaesthesiology from Uniklinik RWTH Aachen, Germany

Annual Scientific Meeting of the Regional Anaesthesia United Kingdom

Nottingham, UK, 12th & 13th May 2014

Plenary session lecture to be delivered by Dr Brian O'Donnell, from University College Cork, Ireland

44th EEE International Symposium on Multiple-Valued Logic

Bremen, Germany, 19th to 21st May 2014

Participation of University of Zilina, Slovakia

Euroanaesthesiology Congress of the European Society of Anaesthesiology

Stockholm, Sweden, 2nd June 2014

Plenary session lecture to be delivered by Dr Brian O'Donnell, from University College Cork, Ireland

9th International Conference on. Dependability and Complex Systems

Brunow, Poland, 30th June to 4th July 2014

Participation of University of Zilina, Slovakia

10th International Conference on Digital Technologies 2014

Zilina, Slovakia, 9th to 11th July 2014

Participation of University of Zilina, Slovakia, and Department of Medical Informatics from the Uniklinik RWTH Aachen, Germany

Conferences, seminars & workshops

Forschungscampus STIMULATE

Magdeburg, Germany, October 2013

Invited seminar of Bangor University, UK

Workshop on Smart Medical Materials for the Intensive Care Environment

Bangor, UK, April 2014

Participation of Bangor University, UK

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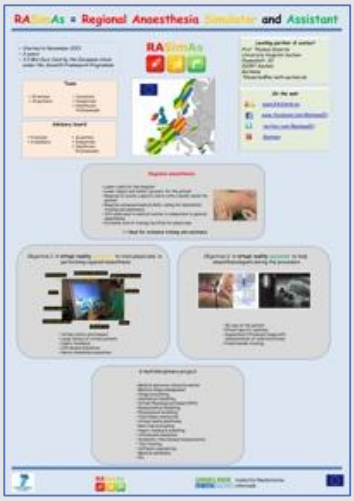
Bildverarbeitung für die Medizin

Aachen, Germany, 16th to 18th March 2014

Poster from Dr. Antoine Serrurier, of the Department of Medical Informatics, Uniklinik RWTH Aachen.



Visual Computing in Biology and Medicine

Aachen, Germany, 19th March 2014

Presentation from Dr. Antoine Serrurier, of the Department of Medical Informatics, Uniklinik RWTH Aachen.

Publications

Elena Zaitseva, Vitaly Levashenko, Miroslav Kvassay, Investigation of system reliability depending on some system components states, 9th Int. Conf. on Dependability and Complex Systems (DepCoS-RELCOMEX 2014), Brunow Palace, Poland, June 30 – July 4, 2014 (accepted)

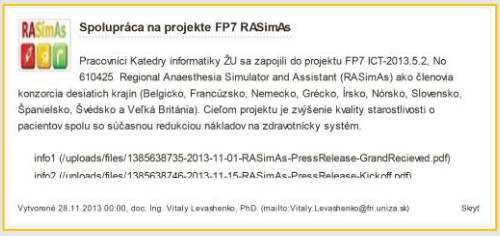
Miroslav Kvassay, Elena Zaitseva, Vitaly Levashenko, Jozef Kostolny, Minimal Cut Vectors and Logical Differential Calculus, 44th IEEE Int. Symp. on Multiple-Valued Logic (ISMVL 2014), Bremen, Germany, May 19-21st, 2014 (accepted)

Seen the media

University of Zilina

November 2013

The project has been advertised on the main page of the University.



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Madri+d

December 2013

The project has been advertised on Madri+d, a Spanish website developed by the regional government (Comunidad de Madrid) to promote the science research, the technological development and the interaction between research centres and privately held local companies.

http://www.madrimasd.org/informacionidi/noticias/noticia.asp?id=58921&origen=notiweb_suplemento&dia_suplemento=lunes&seccion=noticiaslunes

Xplora

December 2013

The project has been advertised on Xplora, the scientific channel of A3Media Corporation, the biggest Media Group in Spain.

http://www.cienciaxplora.com/innovacion/grupo-investigadores-trabaja-aplicar-realidad-virtual-formacion-anestesistas_2013121200084.html

Uniklinik RWTH Aachen

December 2013

The project has been advertised on the main page of the University.

http://www.ukaachen.de/alle-beitraege-aus-news/news/artikel/03122013-europaeische-experten-starten-rasimas-forschungsprojekt.html

Uniklinik RWTH Aachen

November/December 2013

The project has been advertised in the main internal communication organ of the university.

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CURAC

April 2014

The project has been advertised in the newsletter of the German Society for Computer and Robot Assisted Surgery.

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