# RASimAs newsletter

31th October 2015

Issue 4

## Editorial

This is the 4th newsletter of our RASimAs project, delivered after 2 years of work and just right after our 2nd General Assembly, which was held successfully in Bangor UK. Based on effective and intense collaboration between the partners, there is remarkable progress. The simulator and assistant are in the way of being evaluated in the clinical sites and all the partners are motivated to witness the prototypes in work. Furthermore, RASimAs progress is reflected by several scientific publications in international journals and conferences. For regularly updates of the project, follow us on our website (www.rasimas.eu) or via the social networks twitter (twitter.com/ RasimasEU) and Facebook (RasimasEU). Enjoy the reading!

Prof. Thomas Deserno

## 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.*

## Project Highlights

The fourteen partners of the consortium together with the advisory board met at September in Bangor, UK for the second general assembly of the project. These two days were fruitful and intended to gather all the partners working together to deliver the assistant and simulator in time for their evaluation.

## The project in numbers

**27**…achieved deliverables

**9**… milestones met

**12**…conferences

**4**…press releases

**4**…newsletters

**17**…publications

**92**…tweets

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## Words from the partners

### Bangor University, UK

This year's Eurographics Workshop on Visual Computing for Biology and Medicine (VCBM) conference was co-organized by Dr Vidal from Bangor University. The conference was held on the 14th and 15th of September. RASimAs' presence amongst the 44 attendees was high. Five of ours centers were represented: SHACRA team from INRIA, Department of Medical Informatics from University Hospital Aachen, Virtual Reality Group of RWTH Aachen University, Department of Medical Technology from SINTEF, and Visualization, Modelling and Graphics group of Bangor University. In Figure 1 we see some of the participants of the conference.


*Figure 1. Group picture for the conference VCBM*

As from the work realized by the group of Bangor University, Robin (a.k.a. Yi Ding) is currently working on the validation of the electrical nerve stimulation simulator. The main components are now in place and there is the need to assess the clinical value of this work.

### INRIA, France

During this past period INRIA has worked on the computation of haptic feedback during needle insertion. Force feedback is a major aspect of regional anaesthesia since it permits to identify when the needle crosses the different anatomical substructures. Computing force feedback involves detection of contacts between the needle and the anatomy, computation of the needle insertion force (Figure 2), and application of this force to the proximal end of the needle and haptic interface.

*Figure 2. Real-time simulation of needle insertion in a realistic leg model for regional anaesthesia training*

INRIA has also been very active at integrating this work and previous results into the simulator prototype.

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## FORTH, Greece

Upon completion of the Integrated Platform (initial) component, FORTH successfully delivered the Integrated Platform (final) component which enriched the aforementioned one with additional functionalities in both the server and client sides. A major enhancement was the development of a role-based access control (RBAC) system. RBAC is an approach of assigning different roles among authorized users with specific access rights for each of these roles. For illustrative purposes, Figure 3 represents the RBAC system of a local training center. In the global RBAC system, local admins and mentors may only have access to resources of their own training center.

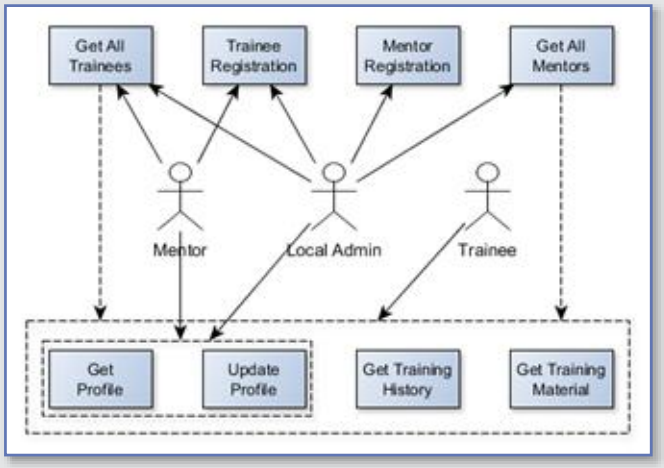


*Figure 3. Local role-based access control system*

FORTH currently concentrates its efforts on the development of a Java-based desktop application (Figure 4) that will enable the fusion of the distinct modelling toolkits, currently used for the generation of patient-specific data and physics-based models, into one single platform that will provide a seamless integration towards the realization of the so called patient-specific virtual physiological human (VPH) model.

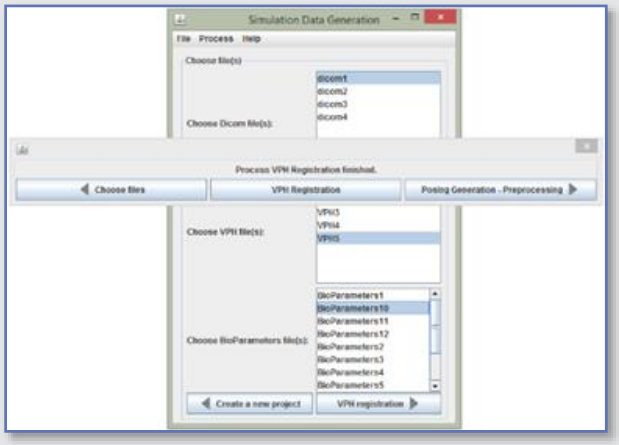

*Figure 4. Toolkit for integration of patient-specific data and physics-based models into VPH models*

Last but not Least, FORTH is also developing an automatic Deformable Medical Image Registration method for the alignment of the generic model (Zygote) into the patient's MRI (Figure 5). Although the results are not yet absolute, they look quite promising.

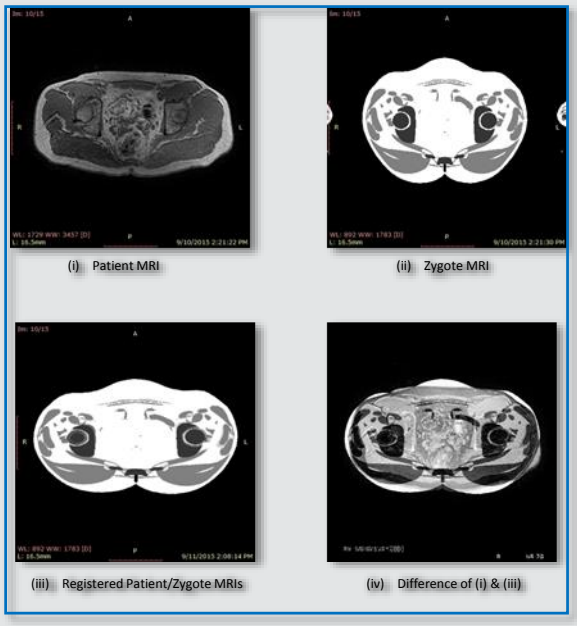


*Figure 5. Automatic deformable image registration method*

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## University of Zilina, Slovakia

Reliability is an important characteristic of every modern system. One of the principal areas of investigation of UNIZA team is reliability analysis of healthcare systems. A typical healthcare system consists of elements of three different types – hardware, software, and the human factor. This implies that healthcare systems are complex and of high-risk. Therefore, the problem of reliability analysis and estimation of these systems in the design phase is important. As a rule, the reliability analysis of a healthcare system is separated in two independent problems: (i) reliability analysis of medical devices and equipment (hardware and software), and (ii) human reliability analysis of medical errors (human factor). However, practical work shows that these problems are not independent and have to be considered together. This novel trend of healthcare system reliability analysis is studied by the UNIZA team: the reliability analysis has to be based on joint evaluation of all principal parts of the healthcare system. This results in promising new methods and mathematical background.

The proposed methodology of a healthcare system analysis is illustrated in Figure 6. The system from the figure includes three elements: physicians, nurses, and equipment for patient checkup. The principal problem of this system is a medical error that is interpreted as the system fault. The typical methods of reliability analysis are able to investigate the human error and technical problem in such system separately. The proposed method will be able to be used to evaluate this system as a whole.

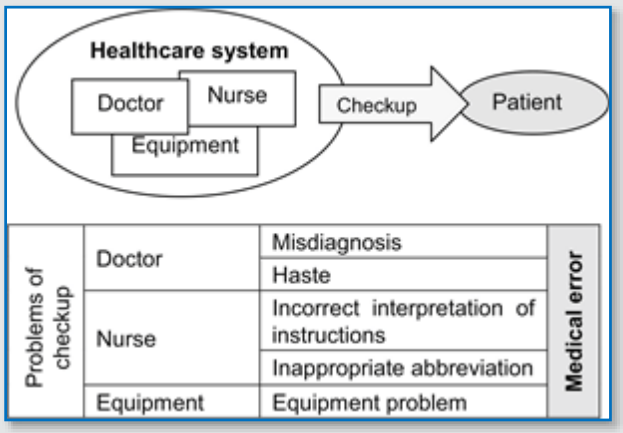


*Figure 6. Methodology of a healthcare system*

## Virtual Reality Centre, RWTH Aachen University, Germany

In the last months, the communication, which takes place between the Ultrasound (US) simulation module and the main software module during runtime, has been extended. More data-fields have been integrated into the information transfer to allow a more detailed control on the US-simulation. It is now possible to create a visual user interface to change US imaging properties as intensity, depth, etc.

Additionally, a special annotated US-image can be rendered and transferred to the main module (Figure 7). The annotations give information, which anatomical structures are visible at each pixel in the US-image. The annotations are created via a special rendering pass using a simplified acoustic model to increase the performance. The annotated image is used by the module that provides the training functionality to assess the trainee's performance and give additional feedback to him.

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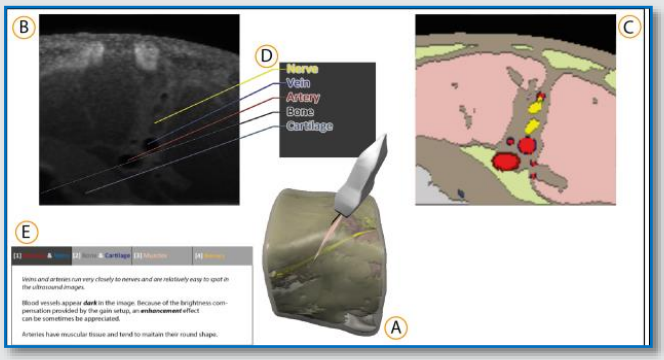


*Figure 7. Screenshot from an example application using the US simulation: A) an anatomical model and virtual ultrasound probe B) Simulated US image C) Annotated and color-coded cross-sectional image of the scanned anatomy D) Annotation pane E) Information pane with descriptions of the viewed anatomical structures*

## University Rey Juan Carlos, Spain

The Juan Carlos University (URJC) group is currently leading one of the key work package (WP). WP4 is in charge of developing the modules that will be integrated in the Regional Anesthesia (RA) Simulator and in the RA Assistant. Most of the RA Simulator modules will be delivered soon. Therefore, during the last six months, the URJC group members are focusing all their efforts on this WP, especially on the courseware module. This module is mainly in charge of guiding the users along their training in the RA procedure.

At this point, the courseware architecture can be considered finished; metrics and supportive information for the first stage of the procedure (the scan-scout phase) have been implemented. The following image (Figure 8) shows the current Graphical User Interface of the RA Simulator.

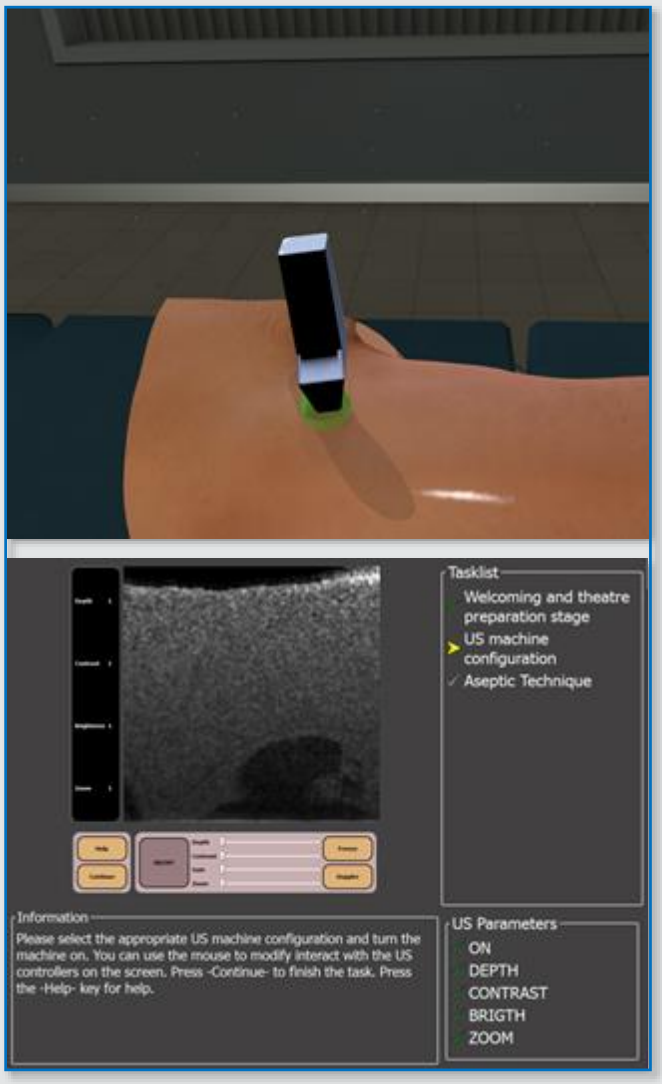


*Figure 8. Graphical User Interface of the regional anaesthesia simulator*

## Dept. of Medical Informatics, Uniklinik RWTH Aachen, Germany

The non-rigid image registration has been one of the current work of the Department of Medical Informatics of Uniklinik RWTH Aachen. The challenge of the work is to consider the individual patient anatomy and use general models to generate patient-specific computer models for

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application in regional anaesthesia procedures. A method for semi-automatic registration of general model data towards partial magnetic resonance image of a real patient has been developed to be used on both the simulator and assistant.

For a female subject, Figure 9 shows on the top the generic Zygote model and on the bottom an example of registration with different orientations regarding the skin, bones and skin together with bones. In a further step, the registration of muscles will be integrated in the process.

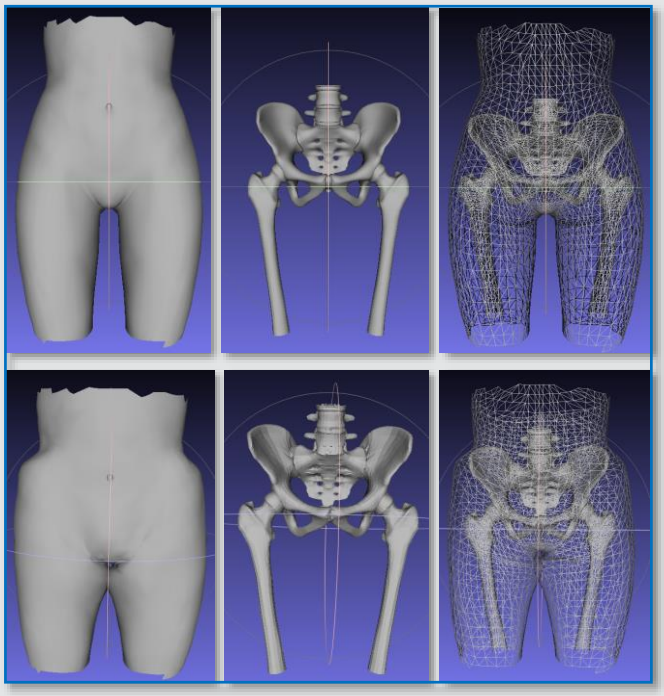

*Figure 9. Zygote female generic VPH (top) and a female subject-specific model (bottom). From left to right: skin mesh, bones, and both surfaces together.*

## SINTEF, Norway

The deadline for delivering the assistant for clinical testing is fast approaching and SINTEF is working hard on transforming an ultrasound system into a RA-Assistant these days, both hardware and software wise. The assistant needs its own computer with a high-end graphics card, a new and larger screen and a switch for toggling between the scanner and the assistant, everything mounted in a single rack configuration for flexibility. Additionally, the assistant needs functionality for assisting the operator in performing an ultrasound-guided femoral nerve block. Currently the focus is on developing software for the first step in such a procedure, i.e. positioning the ultrasound probe and interpreting the images. The assistant software does that by fully automatically and in real-time

a) detect and track the femoral artery in the 2D ultrasound images,
b) assist the operator in positioning the probe,
c) annotate other structures like the femoral nerve when appropriate (Figure 10),
d) reconstruct the artery (and possibly other structures) in 3D and
e) aligns a model of the surrounding anatomy to the ultrasound data / patient for reference (Figure 11).

The great challenge is of course to make this robust enough for clinical use. The work was presented at the 5th annual Eurographics Workshop on Visual Computing for Biology and Medicine 2015 in Chester on the 14th-15th of September. Furthermore, an article about the work has also been published in gemini.no, a magazine that brings up-to-date research news from the Norwegian University of Science and Technology (NTNU) and SINTEF.

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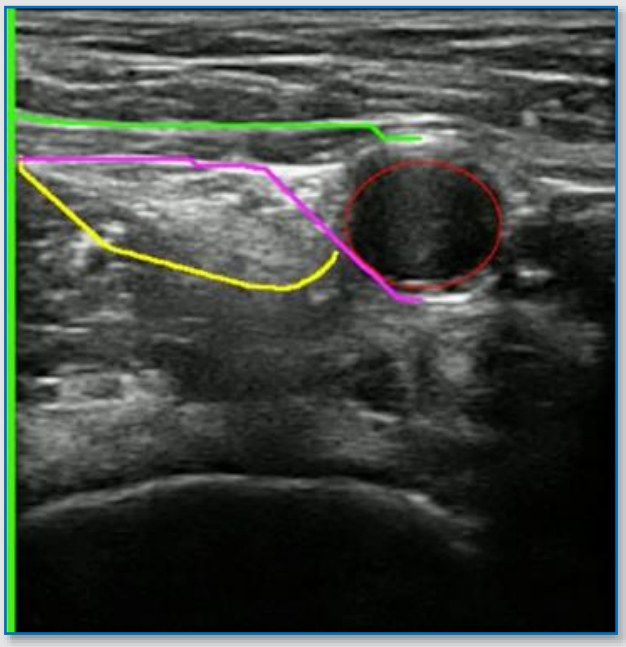

*Figure 10. 2D view*

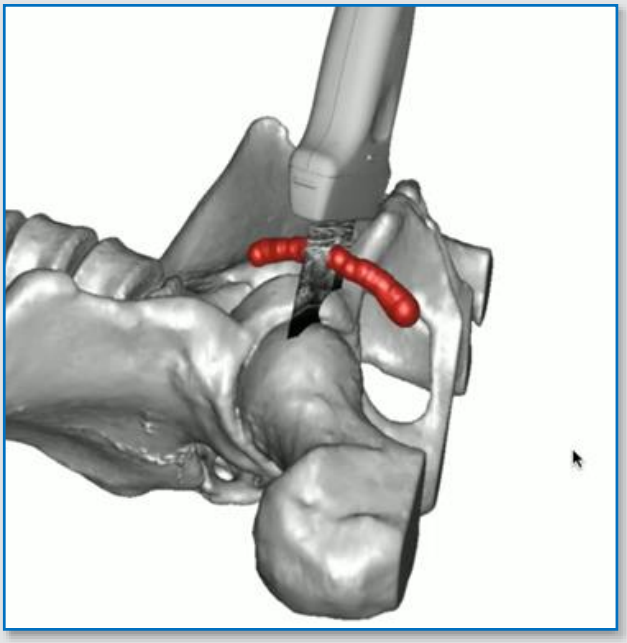

*Figure 11. 3D view*

## SenseGraphics, Sweden

SenseGraphics (SG) is an industrial technology partner in the development of RASimAs a next-generation Regional Anesthesia training simulator. The main contribution of SG is to develop state of the art hardware technology platform to meet the current healthcare/medical simulation market. In this regard an exploitation plan has been outlined by SG to introduce RASimAs in the healthcare market as soon as the clinical trials are validated.

As the project comes into the final year of development, RASim (Simulator) prototype demonstrates the key features of the regional anesthesia. These include: multiple views (Patient view and Ultrasound view), virtual ultrasound guided nerve blocking and haptic guided needle insertion procedure (Figure 12).

Keeping the clinicians point of view, RASim is well integrated with 6DOF haptic device to assist the users with needle insertion force feedbacks reflecting a realistic needle insert feeling as it penetrates through different tissue layers in an augmented reality environment. RASim further supports a 6DOF three dimensional magnetic tracker to measure the positions and orientations of US probe in 3D space.

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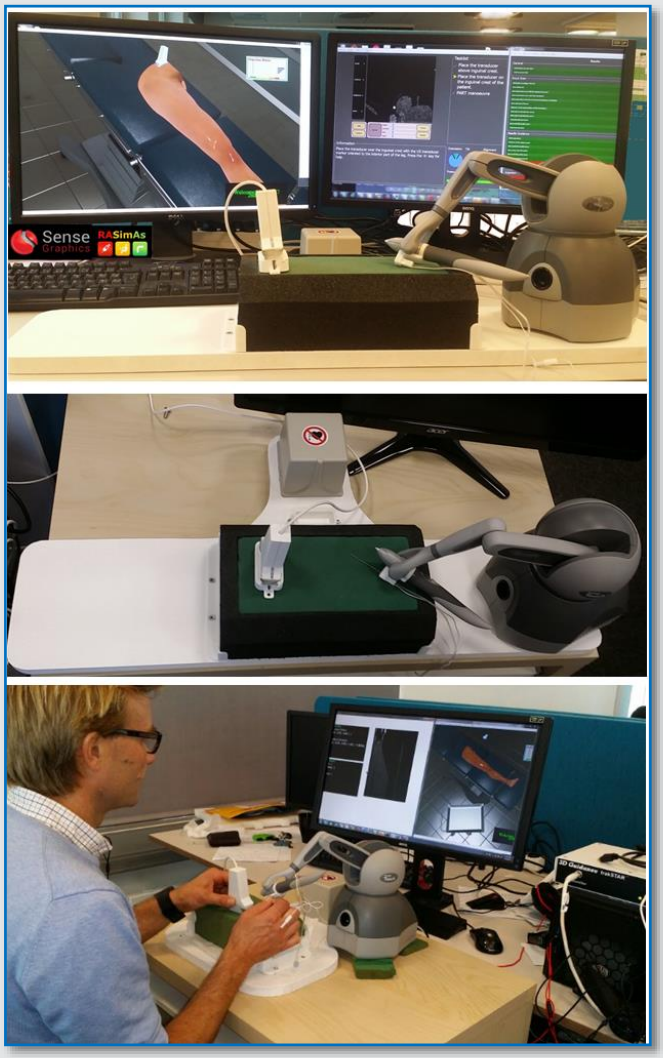


*Figure 12. RASim Prototype*

## University College Cork, Ireland

As the second year of the RASimAs project comes to an end, we are tantalizingly close to realizing the hard work of our technical partners. The completion of the first prototypes of the simulator and assistant systems will allow our clinicians to formally evaluate both functions in real world settings. The clinical team of regional anaesthesia collaborators, in liaison with the clinical trials centre RWTH Aachen University, have been busy designing studies to evaluate the validity and utility of the new technology.

It is widely known in learning a new technical skill, those new to the particular skill will make errors until they develop a level of technical proficiency. This is true of all skills irrespective of context. A person learning to play piano, drive a car, paddle a canoe or perform ultrasound guided regional anaesthesia will need to invest time perfecting the specific skill until proficiency is reached. Unfortunately in the clinical arena, few learning opportunities exist to permit novice learning in a risk free environment. Most clinicians learn by doing. Therefore patients are exposed to novice behaviors and associated errors until proficiency is obtained. We believe that the creation of a bespoke simulated learning environment (RASim) will enable skills acquisition in a risk free environment.

RASim will be evaluated by comparing standard, 'best available' training, in ultrasound guided femoral nerve block to 'best available' training augmented by RASim. Our hypothesis states that novice anaesthetists who receive augmented training using RASim, and who attain a level of proficiency in the simulation learning environment, will perform better and make fewer errors when compared to novices in the control group. This study will be conducted at each partner site in Aachen, Leuven and Cork. Trainee anaesthetists will be invited to participate and will be randomized to receive either standard or RASim augmented training. On completion of training, videos will be obtained of trainee

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performance of ultrasound guided femoral nerve block in a clinical setting (Figure 13). Trainee performance will be assessed using an objective validated assessment tool specifically designed by researchers at the ASSERT for Health Centre, University College Cork.

The RAAs, physician assistant prototype is an exciting and innovative tool. Image interpretation in ultrasound guided regional anaesthesia is complex and challenging. The clinical team posed the following challenge to our technical partners: 'Design an image interpretation tool that would lessen the cognitive burden of the anaesthetists and reliably identify nerve anatomy in ultrasound guided femoral nerve block'. The result has been a ground breaking tool that automatically interrogates the ultrasound image and points the clinician toward the correct anatomical feature. This device will permit correct image interpretation even by novices in ultrasonography. Therefore we will evaluate this assertion by using the device in a volunteer cohort of medical students without formal training in ultrasonography or sonographic image interpretation. Again this study will be performed at the partner sites.

The prospect of realizing two years of collaborative efforts is very exciting. We are confident that the prototype devices soon to be delivered will yield a significant learning and performance effect on those engaged in ultrasound guided regional anaesthesia.


*Figure 13. Femoral nerve block*

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## Publications

### An assistant for improved ultrasound-guided regional anaesthesia of the femoral nerve

*Smistad E, Lindseth F*

In: MedViz Conference; 2015 June 15-16; Bergen, Norway; 2015

**Best presentation award**

### Simulation-based ultrasound training supported by annotations, haptics and linked multimodal views

*Law YC, Knott T, Pick S, Kuhlen TW*

In: Eurographics Workshop on Visual Computing for Biology and Medicine; 2015 Sep 14-15; Chester, UK; 2015

### Image registration methods for patient-specific virtual physiological human models

*Oliveira JEE, Giessler P, Deserno TM*

In: Eurographics Workshop on Visual Computing for Biology and Medicine; 2015 Sep 14-15; Chester, UK; 2015

### Automatic real-time annotation of important landmarks in ultrasound-guided femoral nerve blocks

*Lindseth F, Leidig L, Smistad E*

In: Eurographics Workshop on Visual Computing for Biology and Medicine; 2015 Sep 14-15; Chester, UK; 2015

### Combining image processing libraries for patient-specific anatomical modelling

*Oliveira JEE, Serrurier A, Keszei A, Giessler P, Deserno TM*

In: Proceeding 60th GMDS; 2015 Sep 06-09; Krefeld, Germany; 2015

### Training of regional anaesthesia supported by patient-specific virtual physiological human (VPH)-based models

*Grottke O, Oliveira JEE, O'Donnell B, van de Velde M, Greindl A, Rossaint R, Deserno TM*

In: Proceedings of 34th Annual ESRA Congress; 2015 Sep 02-05; Ljubljana, Slovenia; 2015

### Towards realistic patient-specific human models for virtual reality regional anaesthesia simulation

*Serrurier A, Herrler A, Deserno TM*

In: Proceedings of 34th Annual ESRA Congress; 2015 Sep 02-05; Ljubljana, Slovenia; 2015

### A user needs assessment of simulated learning environment in regional anaesthesia

*O'Donnell B, Grottke O, Deserno T, van de Velde M, Coppens S, Burns C, 'Gallagher A*

In: Proceedings of 34th Annual ESRA Congress; 2015 Sep 02-05; Ljubljana, Slovenia; 2015

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### An interactive algorithm for virtual patient positioning

*Casafranca JJ, Sujar A, Garcia M*

In: Proceedings of Congreso Espanol de Informatica Grafica; 2015 Jul 01-03; Benicassim, Spain; 2015

### Importance analysis of multi-state systems based on integrated direct partial logic derivatives

*Kvassay M, Zaitseva E, Kostolny J, Levashenko V*

In: Proceedings of the Int Conference on Information and Digital Technologies (IDT 2015); 2015 Jul 07-09; Zilina, Slovakia; 2015. p. 183-195

### New parallel algorithm for the calculation of importance measures, theory and engineering of complex systems and dependability

*Zaitseva E, Levashenko V, Kvassay M, Kostolny J*

Advances in Intelligent Systems and Computing. 2015; 365:563-72

### New algorithm for calculation of Fussell-Vesely importance with application of direct partial logic derivatives, safety and reliability of complex engineered systems

*Zaitseva E, Levashenko V, Kvassay M, Kostolny J*

In: Proceedings of the European Safety and Reliability Conference (ESREL 2015); 2015 Sep 07-10; Zurich, Switzerland; 2015

### Introduction to knowledge discovery in medical databases and use of reliability analysis in data mining

*Zaitseva E, Kvassay M, Levashenko V, Kostolny J*

In: Proceedings of the IEEE Federated Conf. on Computer Science & Information Systems (IEEE FedCSIS'15); 2015 Sep 13-16; Lodz, Poland; 2015

## *Upcoming events*

### 2nd RASimAs Coding Sprint

*Aachen, Germany, 30th November to 4th December 2016*

Participation core partners responsible for coding to integrate the software

### RASimAs Investigator's Meeting

*Leuven, Belgium, 9th and 10th December 2015*

Participation of all the partners involved clinical evaluation and conducting the trials

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### Annual review meeting of the project with European Union

*Leuven, Belgium, 15th January 2016*

Participation of all the partners involved in the second year of the project

## *Conferences, seminars & workshops*

### 10th International Conference on Dependability and Complex Systems

*Brunow Palace, Poland, 29th June – 03rd July 2015*

Participation of the University of Zilina, Slovakia

### International Conference on Information and Digital Technologies

*Zilina, Slovakia, 07th-09th July 2015*

Participation of the University of Zilina, Slovakia

### European Society of Regional Anaesthesia and Pain Therapy (34th)

*Ljubljana, Slovenia, 02nd – 05th September 2015*

Participation of the University College Cork, Ireland

### 60th GMDS

*Krefeld, Germany, 06th – 09th September 2015*

Participation of the Department of Medical Informatics, Uniklinik RWTH Aachen, Germany

### European Safety and Reliability Conference

*Zurich, Switzerland, 7th – 10th September 2015*

Participation of the University of Zilina, Slovakia

### IEEE Federated Conference on Computer Science & Information Systems

*Lodz, Poland, 13th – 16th September 2015*

Participation of the University of Zilina, Slovakia

### Visual Computing for Biology and Medicine

*Bangor/Chester, UK, 14th – 15th September 2015*

Participation of the Department of Medical Informatics, Uniklinik RWTH Aachen, Germany, Department of Virtual Reality Centre, RWTH Aachen, Germany, Visualization, Modelling and Graphics group of Bangor University, SHACRA team from INRIA and SINTEF, Norway

### 18th International Conference on Medical Image Computing and Computer Assisted Interventions

*Munich, Germany, 5th October 2015*

Stéphane Cotin, from INRIA, gave a keynote for the 10th Computation Biomechanics workshop during MICCAI.

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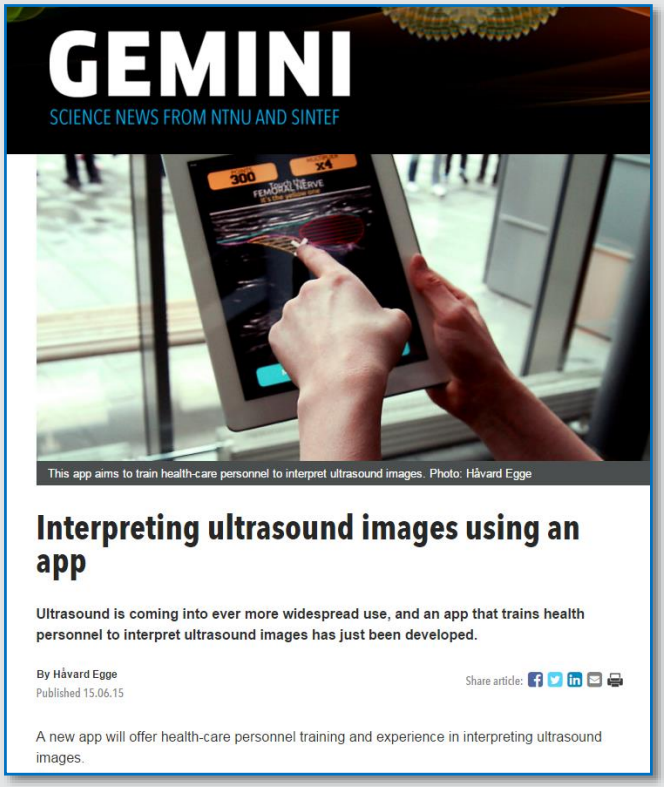
## Seen in the media

### SINTEF

*June 2015*

The project has been advertised on the web page of Gemini (Science News from NTNU and SINTEF).




### Universidad Rey Juan Carlos

*July 2015*

The project has been advertised on the web page of Fundación para el conocimiento (Madrid+d).


### Universidad Rey Juan Carlos

*July 2015*

Interview regarding the project in Diario Medico.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## Universidad Rey Juan Carlos

*July 2015*

The project has been advertised on the web page of URJC.


## Universidad Rey Juan Carlos

*July 2015*

The project has been advertised on a local radio (SER Madrid Oeste) of Madrid, Spain


## Universidad Rey Juan Carlos

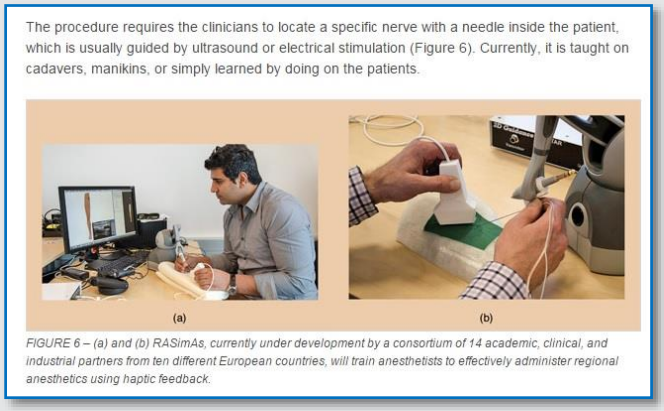
*July 2015*

The project has been advertised on the web page of El Servicio de Información y Noticias Cientificas (SINC).


## IEEE Pulse

*July 2015*

The project has been advertised on the webpage of IEEE Pulse – a Magazine of the IEEE Engineering in Medicine and Biology Society

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## SINTEF

*October 2015*

The project has been advertised on the web page of Gemini (Science News from NTNU and SINTEF). Article in Norwegian.

GEMINI.no

FORSKNINGSNYTT FRA NTNU OG SINTEF

Teknologi Energi og miljø Naturvitenskap Fisk og havbruk Nyskaping Helse Samfunn Hu



Ultralydproben sørger for at legen kan få et godt bilde av anatomien på skjermen, slik at nerven kan lokaliseres og nålen føres inn på riktig plass, forklarer SINTEF-forsker Frank Lindseth. Foto: Kathinka Høyden

**Bedøver med "kirurgisk" presisjon**

**Ultralydteknologi skal hjelpe leger med å sette bedøvelse mer presist. Teknologien utvikles i Trondheim.**

Av Kathinka Høyden
Publisert 29.10.15

Del artikkel:

Ultralyd brukes i stadig flere medisinske sammenhenger, blant annet i diagnostikk, behandling og undersøkelse. Bildeteknikken benyttes også under anestesi; såkalt ultralydveiledet regional

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