Newsletter

N°4 December 2018

URBAN SEARCH AND RESCUE

Technological & Methodological Solutions for Integrated Wide Area Situation Awareness & Survivor Localisation to Support Search & Rescue Teams

www.inachus.eu

Editorial

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Editorial

Dear reader,

I am pleased to introduce the fourth and last issue of the newsletter of INACHUS: A four-year EU project that started in 2015, partially funded by the European Commission under the Seventh Framework Programme for Research and Technological Development (Grant Agreement no 607522). The project involves 20 partners from 9 EU member-states and an associated country.

Urban Search and Rescue (USaR) teams face difficult working conditions and harsh environments. The INACHUS project seeks to increase the overall efficiency of USaR operations by minimizing the amount of time needed to locate victims, while also aiding rescuers to find the safest and most effective way to recover those victims.

The last year of the project has been characterised by many presentation and demonstration activities: The third pilot demonstration has been held on 20 April 2018 at the Training Base Weeze, Germany, and presented the partially integrated solution. At the final project's final demonstration in Roquebilière, France, close to the Italian order, the fully integrated INACHUS solution has been presented and evaluated in the scope of a large-scale scenario.

On 16 October 2018, the Final Event has been organised by INACHUS to present its outcomes in the scope of a dedicated conference. The project's progress and achievements were presented to an interested audience of invited end-users and stakeholders. A panel with USaR professionals gave the opportunity to discuss the future of the obtained technological solutions in the applied USaR methodology and gave food for thought for the following pilot demonstration in Roquebilière.

Further information can be found on the project's official website.

I hope you will enjoy the newsletter.

Angelos Amditis
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INACHUS Final Event

New technologies in the USaR world

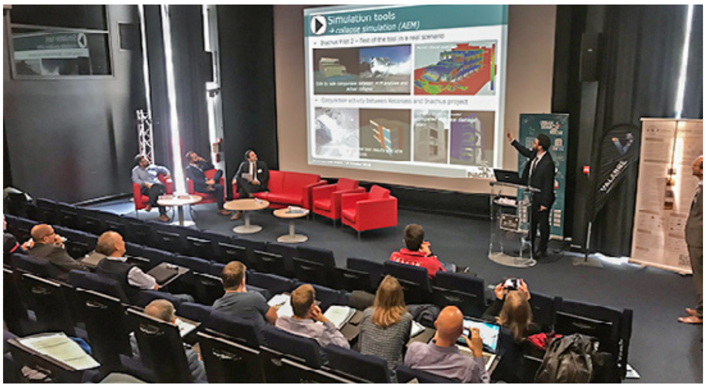
Just few month before the end of the project, the INACHUS consortium organised the Final Event: A dedicated conference to present the project outcomes to more than 40 invited participants. This conference assembled all project partners at Valabre, France, on the 16 October and was co-located with the INSARAG Africa – Europe – Middle East regional meeting, which started the following day.

During the Final Event key representatives from several USaR teams in Europe (Germany, The Netherlands, Italy, France, Greece) were present and participated actively to the conference and the round table on the subject of “New technologies in the USAR world”.

The Final Event gave the participants the chance to get informed about the details of the fully integrated INACHUS system as well as relevant research results that had been obtained in the scope of the project. Project partners presented the software tools to exchange information and to keep track of the progress of the ongoing emergency operation: the Emergency Support System with its digital INSARAG forms and visual analytics, and the Common Operational Picture for situation assessment.

Moreover, the victim localisation tools, which consist of the INACHUS robot and its mounted sensor subsystem, the standalone seismic sensors, as well as the radar systems, and the

secure, autonomous and wireless communication solution, have been shown. Complementing these tools, the building collapse simulation and tools to assess damage in entire city quarters as well as the wide area assessment tools based on the evaluation of 3D data acquired by UAVs were introduced to the audience.



Profound discussions erupted with the project partners and many insights were gathered especially also for the last pilot demonstration that has been carried out a month later.
The INACHUS project is user-driven, involving many end-users that have been regularly consulted to collect insights, needs and remarks, and to validate the project achievements in the scope of four pilots and demonstrations.

Consequently, the final event offered also another excellent opportunity for project partners and invited stakeholders to network and discuss. The project consortium concluded that this fruitful Final Event represented an insightful and informative exchange that prepared the way to a very successful final field demonstration, which took place in November 2018.

The annual meeting

For the INSARAG regional group of Africa, Europe, and Middle East was held during the two days following the Final Event. INACHUS was present in the exhibition area with a stand to inform about the project with posters, newsletters, and leaflets. Very good contact was made with representatives from many countries: Germany, France, Estonia, Czech Republic, Israel, Hungary, Morocco, Tunisia, Italy, Poland, UK, Belgium, Jordan; as well as from the UN Office of the Coordination of Humanitarian Affairs (OCHA).

INACHUS Validation Process

INACHUS Validation Process

INACHUS Validation Process

3rd Pilot Demonstration

Pilot 3 held in April 2018 at Training Base Weeze (Germany), was the first demonstration of the integrated INACHUS system, as well as an opportunity to collect end user feedback. Fifteen urban search and rescue (USaR) professionals from Sweden, the Netherlands, United Kingdom and INSARAG/UN-OCHA attended the INACHUS field test.

Guided by a scenario involving a major earthquake with international help requested, INACHUS partners demonstrated how the various solutions developed in the project could assist in all phases of a USaR response, and through all levels of coordination. Training Base Weeze offered a realistic environment, including a worksite surrounded by rubble, to demonstrate the INACHUS tools.
The field test was very interactive, with hands-on demonstrations of the INACHUS tools:

Emergency Support System (ESS) and Common Operational Picture (COP). Participants assumed roles at different levels of coordination when using the INACHUS COP and ESS software to assist in coordination of the earthquake response. Using the COP, they created sectors, assigned teams to sectors and worksites, and visualized the status of the response progress. With the ESS, they digitally completed the required INSARAG forms, and viewed the analytics dashboard to get an overview of the completed work.

Users had laptops or tablets to work on. Also, the COP and ESS were projected on a large screen, as would likely be used in coordination centres. They saw their inputs arriving in real time, and agreed that this way of working greatly improved the situational awareness of all involved. Progress over the entire affected area down to individual worksites could be seen.

Victim localisation tools. Victim localisation tools were demonstrated in realistic conditions: a complex rubble pile, where volunteers were hidden. At four different places along the rubble the following tools were shown:

- **INACHUS robot.** During the pilot, the end users had a chance to operate the robot. They found a victim using sensors (infrared camera and radar) integrated in the head of the robot. The two-way communication system allowed the end users to communicate with the victim. Very good feedback was gathered from the users, who found the robot easy to operate. They noted that the interface is easy to use and to interpret, including the sensors' output and camera views.
- **Electronic nose.** The electronic nose is part of the INACHUS robot, but was unmounted for the pilot so that it could be shown more thoroughly to users. It is a chemical sensor able to measure gas concentrations in the air of confined spaces in order to indicate human presence as well as

INACHUS Validation Process

hazardous atmosphere. Human presence is detected based mainly on the composition of exhaled breath.
During the demonstration the sensor indicated the presence of a hidden victim by revealing changes in the composition of the air in a void.

- **Seismic sensors.** During the pilot, the seismic system detected different kinds of signals, such as knocking, shouting, tapping and even scraping. Some were very weak, yet still detected. The results were visualized as a 'heat map' on top of a point cloud of the area to show the location of the detectors. The path of a trapped person crawling through a concrete tube could be traced clearly. Loud background noise and shaking from a power generator placed right on top of the rubble was cancelled out, and therefore did not affect the system's ability to detect and locate the victims. The end users were very impressed by the efficiency of the system and agreed that it is a significant step forward compared to tools currently in operational use.
- **Surface radar.** The INACHUS surface radar detects subtle movements in the rubble, such as a victim moving – or even just breathing. It estimates the distance and direction to the movement, to help pinpoint its location faster. The end users found the tool easy to use and the interface simple to understand.

Secure communication network. INACHUS is developing a reliable, autonomous and secure communication network, essential to USaR operations where existing communications means are often either overloaded or simply not functioning. The INACHUS network can be used to share digitally INSARAG forms (completed in the ESS) and other data from the field in real time.

Furthermore, it will allow for communication between the Base of Operations (including the COP) and the worksite, which is a common problem in real missions as end users stated. Shown for the first time in Pilot 3, the communication network will be finalized for Pilot 4.

Findings and future work. The morning of the pilot day was dedicated to the introduction of the scenario and the coordination tools (ESS and COP). Afterwards, the victim localization tools and the communication solution was presented. Participants were very interested in the development of the INACHUS tools, which they anticipate adding significant value to their current operations. They offered useful feedback for continued progress and expressed interest in remaining involved in the project's development.

The INACHUS consortium benefitted greatly from the received end user feedback, with ideas for further improvements that have been integrated for the project's final field test.

Victim localisation tools

Radar Systems

When buildings collapse it is important to quickly localize the trapped victims to be able to perform an efficient rescue operation. Digging in the right place means more lives saved. The INACHUS methods in Simulation tools and Wide area surveillance will provide information for the Victim localization to narrow down the fine-search to the area most probable to find survivors.

Cinside's tasks in the INACHUS project are to adopt their current radar systems, initially made for finding humans behind walls in security applications, to be effective and easy-to-use tools in USaR operations. Three new systems are developed, built and tested. The overall design, electronics, signal processing and user interface, are developed by Cinside and the antennas by FOI.

SurfaceRadar a.k.a. HumanFinder

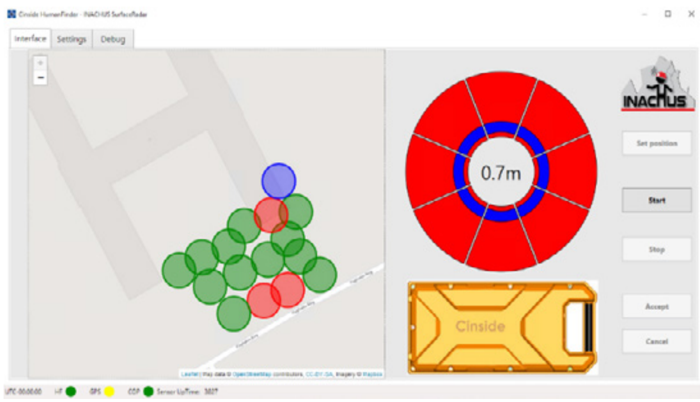
The purpose of the SurfaceRadar is to locate subtle movements in the rubble, from the surface. A unique feature is that it can indicate the direction to the movement, to reduce the area to dig.
The SurfaceRadar system consists of two parts:

- The Operator Control Unit (OCU), operator control unit, has an easy to use graphical interface and has the communication link to the INACHUS network, housed in a ruggedized tablet computer.
- The radar sensor, the orange-black box, is an Ultra-Wide Band (UWB) beam steering radar that performs the measurements. It enhances the high range resolution of an UWB radar with beamforming to get better location information of the target.

The user interface is intuitive and easy to use. In the picture to the right the main view is shown. The buttons to control the measurements, here on the right side, can be placed to the left for easy left-handed operation. The complete operating procedure is covered in four steps by these buttons, making the SurfaceRadar very simple to operate. Next to the buttons is the main indicator showing the distance and the direction to the detected movement. The left part contains a map presenting the current position of the sensor (blue) and past measurement results (green: no movement detected, red: movement detected).

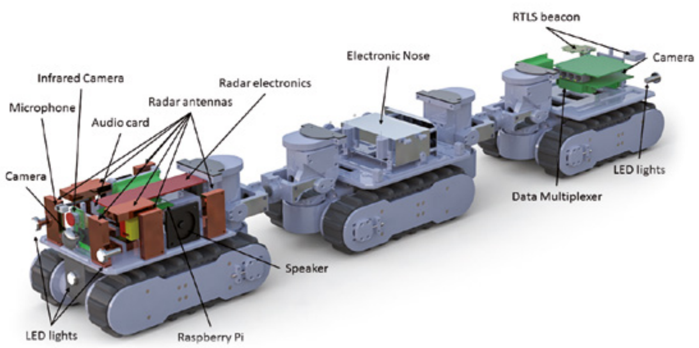
All measurement data and positions are stored locally in the SurfaceRadar OCU for documentation and post analysis. When connected to the INACHUS network, processed measurement results are also distributed to the ESS.

During the Pilot 4 demonstrations the SurfaceRadar was able to detect slight movements through a mixture of building materials in the rubble pile, as well as behind a concrete wall of an unsecured building.
The end users found the tool easy to use and the interface simple to understand. However, the penetration depth was limited and did not yet reflect the full potential of the system.



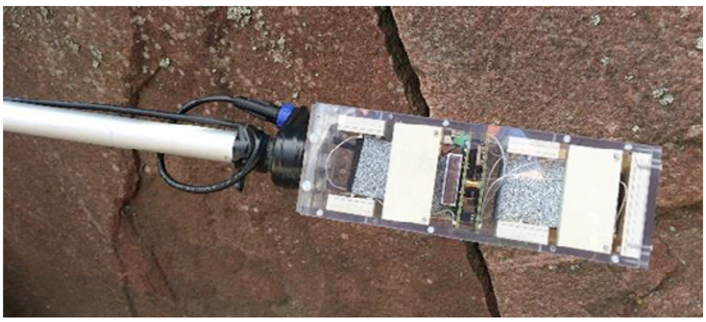
Victim localisation tools

RobotRadar



The RobotRadar is a miniaturized Doppler radar system and one of several sensors integrated in the INACHUS Robot by the partner SINTEF. The robot is intended to crawl into the rubble and get closer to the trapped victims, increasing the chance to find deeply buried humans. Sensors are positioned, facing in five directions around the robot body. This gives a good estimation of the direction to the detected movement. Detections are visualized on the robot operator control unit with easy-to-interpret symbols.

SickRadar



The INACHUS Robot and the RobotRadar were developed during the same period and a mock-up for the robot was needed to be able to test the radar before the robot was available. This special test-platform was further developed to a new product, the StickRadar. It consists of the same radar system as in the RobotRadar, but instead of a robot it is mounted on a telescopic stick and it will have its own OCU, a ruggedized tablet computer, making it a stand-alone system. Additional features include sensitive accelerometers to sense knocks from victims or other vibrations in the construction

as well as a front looking camera to assist the operator.

The StickRadar will be a complement to the other systems, it does not reach as far into the rubble as the robot but will be much easier and faster to deploy. This application is patented.

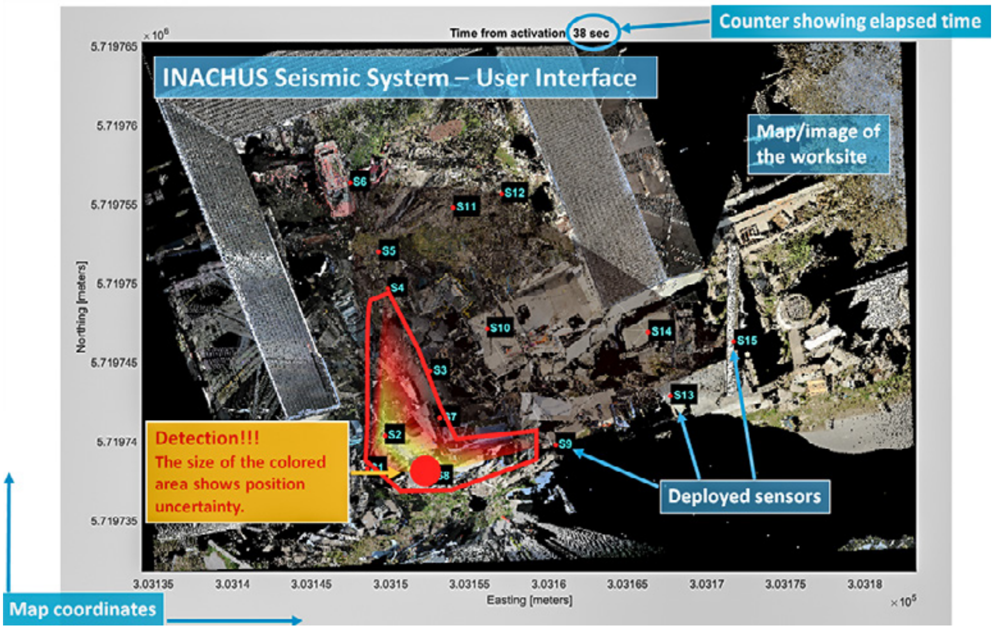
The response from the USaR professionals during Pilot 4 was great regarding the operating procedure and the ease of use of the systems. Though it will still take time to find victims, it will be more efficient than only using the tools available today.

Detecting movement through rubble is very challenging and the performance of radar systems in general varies significantly depending on the materials and structure of the rubble.

The presented tools need to be productified and made available to the market as soon as possible. The end-users offered useful feedback for continued progress and expressed their great interest in remaining involved in the project's development. See an animated video on how to use the radar systems [http://humanfinder.eu.](http://humanfinder.eu)

The INACHUS seismic system for victim detection

The purpose of the INACHUS Ground-based Seismic System (GBSS) is to automatically detect noise, such as knocking, hitting and shouting, produced by victims trapped in the rubble.



The GBSS consists of fifteen vibration-sensitive sensors (geophones), a laptop for data processing plus low-noise cables and amplifiers for connecting the sensors to the PC. The signals detected are visualized on a map in a graphical user interface to make it easy to understand what is going on and where signals are coming from.

At Pilot 3, the GBSS was deployed on a rubble pile to detect and locate a person acting as a victim in the tunnels underneath the debris. A large power generator was placed on a concrete slab on the rubble to test and demonstrate the system's ability to detect signals even in the presence of very strong background noise.

End users appreciated the intuitive graphical presentation of the results and the possibility to automatically detect signals from a (simulated) victim in a noisy environment where the current equipment available in USaR operations, so called "listening systems", probably would not have been very useful.

The Electronic Nose

The (e-nose) sensing device prototype, which is developed by M2G, was tested this year in the 3rd Pilot and has been updated. It can now detect many typical air related hazards in addition to a victim's presence. The user interface was also updated to include the new functionality as well as provide simple alarm outputs. Furthermore, it was installed on the INACHUS robot platform as part of its sensor payload. A series of technical tests have been performed in preparation for the forthcoming field test (Pilot 4) of the integrated solution. The e-nose is inside the central compartment of the INACHUS robot and its user interface is on the right side of the INACHUS robot control interface tablet.

Coordination and training

Common Operational Picture

Efficient coordination is the key to save as many lives as possible during an emergency response. Certainly, a serious drawback in current USaR operations represents the paper-based information management, which as a result makes information travel slowly. The Inachus Common Operational Picture (COP) and the Emergency Support System (ESS) have been developed with goal to relieve this bottleneck.

The ESS forms app is an app for mobile devices, which provides the INSARAG forms destined for the formal operation management, in digital version. The app avoids unnecessary user inputs by automatically prefilling form fields if possible, and sends the data to the ESS server. Synchronising with the ESS server, the COP gives the possibility to accumulate relevant geo-referenced information on a 2D/3D map visualization. The sectorization of the crisis-affected are can be performed directly on the digital maps, and the mobile version of the COP can be used to mark worksites and points of interest when working in the sectors.

The possibility to work collaboratively with multiple users on the same scene in real-time is the characterising feature of the COP. 3D building models, acquired 3D data sets or other available GIS data can enrich the visualized 3D environment of the COP, too. All this is designed to make it easier for USaR professionals to assess the situation, to keep a clear overview of its evolution, and thereby raise the situational awareness levels of each USaR team member. During the pilot demonstrations of the project, the ESS and the COP received a lot of positive feedback from USaR professionals.

Training material package

The results of the INACHUS project will include a number of technological solutions, intended to support the search and rescue operations by a USAR team. Some of these INACHUS solutions will be available as prototypes of actual tools and devices. Examples are the Common Operational Picture (COP), and the INACHUS robot with the electronic nose, the thermal camera, radar and other sensors. In other cases, new working methods will be delivered. Take for example the approach that uses cheap UAVs for quickly making 3D models of collapsed buildings. This can help to determine the best strategy to access rubble pile searching for victims.

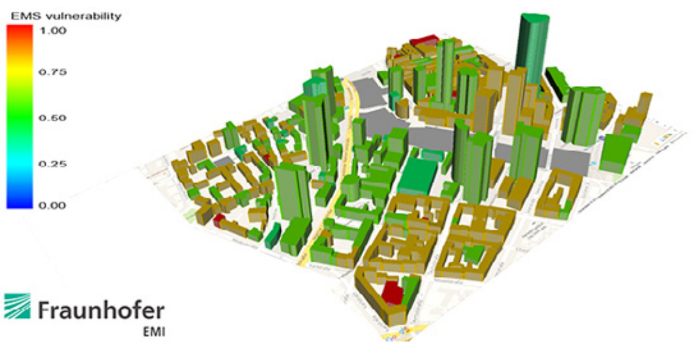
An INACHUS training material package is developed to assist USAR team members, such as search and rescue specialists, structural engineers and operations officers, in the potential of the INACHUS solutions after the end of the project. Focus of the training material is on creating awareness about the different INACHUS solutions, and on learning to operate selected tools and devices. Overall emphasis is on self-paced learning by individual USAR team-members, using a diverse package of infographics, slide decks, videos and rugged field cards. A standard visual design is applied, to provide the users with a coherent training material package. All training material will be made available on an online platform.

Collapse simulation and analysis

Assessing city quarter damage

Among natural disasters, earthquakes can be accounted the most catastrophic ones. The strongest 1100 earthquake events in the last century caused an estimated total number of between 1.3 and 1.53 million casualties. Although the loss of life in such an event can have different reasons, the dominant one in around 75% of all fatalities and injuries is trauma caused by debris collision, mainly due to (partially) collapsing buildings. However, in almost all cases, some buildings are very heavily destroyed, but others – under the same loading conditions – remain stable.

The vulnerability of buildings depends on various aspects, e.g. the construction type, the applied materials and the quality of the design and construction, to name just a few. These differences in vulnerability lead to the fact that buildings respond differently to abnormal loading situations. While in one case (e.g. a masonry structure) an earthquake or a comparable threat extravagates the loading limits, in another case (e.g. a modern reinforced concrete building) the resistance is much higher.



Besides the structural aspect, a more important one is the question how many people are affected by the loss of a building's structural integrity. Considering the above-mentioned examples, one may assume that the masonry structure is an old industrial building, while the reinforced concrete structure may be a modern residential complex nearby. Depending on the time of the event, one of these buildings may be nearly empty, whereas much more people stay in the other. If e.g. an earthquake occurs during the night, it is supposed that only a few people are in the industrial building (e.g. for monitoring some processes), whereas much more people stay in the same building under normal operation conditions at forenoon. The opposite is true for a residential complex. People will be out for work or school most of the time of the day, but gather together in the evening and for the night.

The combined information of the extent of structural damage and a probability estimation of peopled affected, can be a very useful information for USaR teams in the early response phase to organize their rescue activities target-oriented and efficiently. The INACHUS mapping tool, based on a software for analyzing the vulnerability and probability of structural damage of whole city quarters in case of extreme loading conditions developed for the VITRUV project, tries to bring together exactly these two aspects. On the one hand, the structural damage of buildings in a large domain is determined and – on the other hand – overlaid with the expected number of present people in each individual building. Thereby it is possible not only to identify hot spots of damage but to evaluate simultaneously the consequences in terms of the number of affected people in a large urban domain.

The mapping tool uses different methods to determine the structural damage. For a rough damage estimation the European Macroseismic scale is implemented, which relates the damage of a building to its design quality and the intensity of the earthquake. A second, more detailed approach considers the design of pre-defined building types, by the combination of its real resistance to horizontal forces and the location and magnitude of the earthquakes epi-centre. A major advance in the development is the new possibility to import real earthquake data from ShakeMapsdirectly. This homepage – hosted by the United States Geological Survey, a US American federal institution – records and delivers relevant earthquake data, including the exact position of the epi-centre and ground accelerations on a real-world coordinate basis, almost instantly after the event. This data can now be used to feed the mapping software and allows thereby

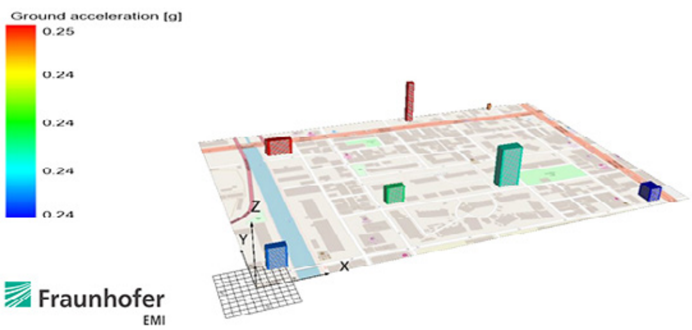
Links

https://www.emi.fraunhofer.de/en/service-offers/software-solutions/vitruv-tool.html

https://earthquake.usgs.gov/data/shakemap/

Collapse simulation and analysis

to apply real-life ground accelerations on the specific domain of interest. The need to enter the position of the epi-centre manually and the coarse estimation of ground accelerations by a scientific attenuation curve is no longer necessary.



In order to relate the data to real world coordinates, the mapping tool includes in addition now the possibility to link the model with real map data. Whereas the model can be set up in an arbitrary coordinate system, it is now possible to import maps from the OpenStreetMap project and to project the real coordinates on the city model. Not only makes this step the use of ShakeMap data possible, it allows USaR teams furthermore the identification of damage hot spots in real world coordinates for a prioritization of rescue operations.

After identifying relevant hot spots, it is possible to evaluate each building individually by means of detailed simulations of the building with appropriate methods and specific software in order to investigate possible locations of voids and the debris heap's stability.

During the project, two methods, the Applied Element Method and the Discrete Element Method were already used to simulate the debris pile of different pre-defined building types under different loading conditions. These first results may be used as a first-guess approach for similar buildings under similar loading conditions.

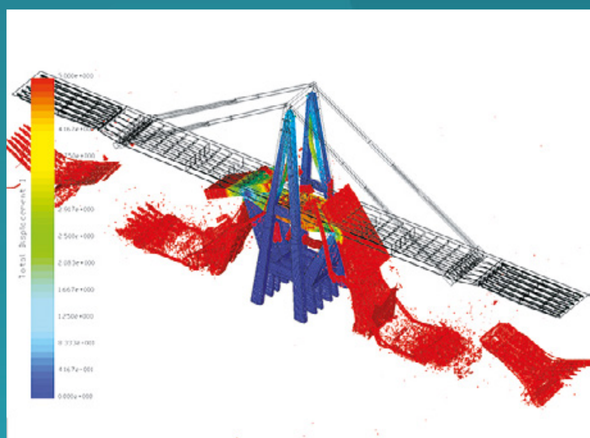
A further possible application of the mapping tool can be within training activities of USaR teams to be well prepared if a disruptive event occurs.

The described new features of the mapping software were requested by end users during the first larger demonstration of the mapping software prototype during a simulated exercise in Spain, 2017. The fruitful discussions and the resulting implementations highlight once again the continuous communication with end users and the strong commitment of the INACHUS community to realign and adapt its developments to the specific end user requests in order to develop technology, which may really help USaR teams in their efforts to save lifes.

Morandi Bridge collapse in Genoa, Italy

The Morandi Bridge, designed by Prof. R. Morandi, was built in the 1960s. It was one of Italy's most important bridges with pre-stressed concrete stays. The bridge collapsed on August 14, 2018, causing 43 deaths.

ASI performed a structural analysis using the Applied Element Method, implemented in the software Extreme Loading for Structures®, with the aim to analyse the assumptions behind the collapse of the bridge.



The comparison between the resulted collapse dynamic and the video of the collapse provides some point of consideration. A detailed article is available at the following link:

http://www.appliedscienceinteurope.com/the-morandi-bridge-in-genoa-analysis-with-the-applied-element-method/

INACHUS and data protection

Whole Europe is talking nowadays about privacy due to the General Data Protection Regulation, GDPR, that entered into force in 2016 and the application began in May 2018. Now everyone should be following the obligations laid down on organizations all around the world. Yes. World. The territorial scope of regulation is not only the boundaries of Europe, but anywhere in the world where personal data is processed for example in the context of offering goods or services or monitoring European citizens.
What is data protection?

Many organizations have been forced to rethink and renew their privacy and data protection principles and methods. The focus is very often in the question “How are we compliant to the regulation?”. What should we do to avoid the fines and problems with the authorities? When that is actually NOT the question to begin with. In fact, GDPR does not state anything about HOW things should be done. It is all about WHY things should be done.

The term ‘privacy’ is all about respecting our private life, our family life and our homes and everything related. This is the answer to the question “Why are we doing this?” and it is the goal we are working for. The term ‘data protection’ is the answer to the question “How we do things ethically?”. It is about fair processing, transparency and protecting our personal data. It is recognizing and controlling the risks our processing might cause to people whose data we collect and store. It is ensuring we do not violate anyone’s private life more than is necessary or acceptable.

What data protection means in INACHUS?

LAUREA’s responsibility has been to conduct Data Protection Impact Assessment (DPIA) with the help of other teams. It is defined in the General Data Protection Regulation and it is a sort of risk analysis that focuses on privacy and data protection risks. The goal is to recognize the danger spots in data processing and to help avoid possible negative consequences to rescue workers’ and victims’ privacy.

INACHUS is a complex solution which facilitates the surveillance of large areas. It will collect and process very much data. From the Regulation’s point of view it is also an intrusive system: It makes it possible to collect personal data without consent or even informing the targeted people what is collected, how and to what extent. When taking videos, images or mobile phone user data everything and everyone is included. Hardly anyone has a chance to influence on what is done with the data later on.

The data processing is targeting people that are also in vulnerable situation. They have very little to say on how the data about them is processed. Imagine what would it feel like to see pictures of badly injured relatives or close people from media? People have to trust us being professionals for not causing them any more harm. So why are we doing these risk assessments? Why are we talking about the ethics of our solution?

Apart from the dozens of obligations laid by the regulation, the reason is simply the respect for everyone’s right to private life. Not just the victims, but also the users of INACHUS and the rescue workers equally. Every process, every component and all the functionalities of INACHUS have to be evaluated to find out and mitigate any risks the use of the INACHUS solution might cause. To protect our rights and ensure they are taken into consideration in the flow of operations. It is about quality and professionalism. But first of all, it is respecting our values, freedoms and rights - the European way of life.

Standardisation effort

Towards a standard for usar robotic platforms

All of the products and services we buy and use in our everyday lives have to meet certain standards. In Europe, these standards are developed by and agreed on by the three officially recognized European Standardization Organizations: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI). Together, CEN and CENELEC provide a platform for the development of European Standards and other technical specifications across a wide range of sectors.

Within INACHUS context, a high need of formulating a well-defined framework ensuring interoperability between USaR robotic platforms and the components of them was identified. Thus, an opportunity exists for the development of an interoperability framework for functional components of modular search and rescue robotic platforms, providing a best-of-breed approach in utilising specialised sensors via interoperable interfaces for USaR operations.

INACHUS initiated a CWA (CEN/CENELEC Workshop Agreement) entitled "Urban search and rescue (USaR) robotic platform technical and procedural interoperability – Guide". A CWA is an agreement developed and approved in a CEN Workshop; the latter is open to the direct participation of anyone with an interest in the development of the agreement. There is no geographical limit on participation; hence, participants may be from outside Europe. The development of a CWA is fast and flexible, on average between ten to twelve months. INACHUS CWA main aim is to provide recommendations in order to enable technical interoperability (hardware, software) between urban search and rescue (USaR) robotic platforms and the equipment, sensors and tools that are attached to them.

This CWA also provides guidance on the principles for enabling USaR robotic platforms (various types of them such as drones, snake-like, robots with wheels, legs, etc.) to operate in all ground search environments. In this way a generic platform can be adapted, designed and built for any possible search and rescue (SAR) scenario on the ground.

The proposed CWA aims at providing recommendations for a generic search and rescue robotic platform. The platform can perform activities in the ground environment and might require a range of sensors and communication interfaces dependent on the search and rescue scenario. In this way a generic platform can be adapted/designed and built for any possible search and rescue scenario.

The proposed CWA builds on the experience gained by the partners during its implementation and the results of the validation during the On-Site Integration Pilots. INACHUS is attempting to increase successful USaR operations by establishing an effective USaR operations framework that aims at rapidly assessing the potential of locating entrapped victims.

Link

https://www.cencenelec.eu/

Events & Conferences

Publications and Presentations in 2018

- A paper entitled "3D laser imaging techniques on UAVs: Detection and localization of collapsed buildings and trapped victims" has been presented at the **International Lidar Mapping Forum** (ILMF) and the **ASPRS Annual Conference** in Denver, Colorado, USA, 5-7 February 2018.

- At the **Security & Counter Terror Expo: Secure - Design - Build** held in London, UK, 6-7 March 2018, INACHUS had been present with the **presentation** "A 3D urban planning tool quantifying urban risk and resilience".

- The presentation "Snake robots for emergency response" has been given at the **workshop** of the **European Robotic Forum** in Tampere, Finland, 15 March 2018.

- INACHUS organised a **CEN-CENELEC Workshop Agreement** Kick-off meeting by the title «Interoperability framework for functional components of a modular search and rescue robotic platform" in Brussels, Belgium, 9 May 2018.

- Participation at the **Swedish Microwave Days** that took place at Lund University, Sweden, 24-25 May 2018, with a **poster presentation** titled "Low Cost Aperture Coupled Patch Antenna Design".

- A paper entitled "Satellite image classification of building damages using satellite and airborne image samples in a deep learning approach" has been presented at the **ISPRS Technical Commission II Symposium** "Towards Photogrammetry 2020" in Riva del Garda, Italy, 3-7 June 2018.

- INACHUS participated at the **5th International Workshop on Emergency Networks for Public Protection and Disaster Relief** (EN4PPDR) in Limassol, Cyprus, 15 October 2018 with the paper "A resilient, multi-access communication solution for USaR operations: the INACHUS approach".

- A paper with the title «Prognosefähige numerische Simulationen als Nachweismethode: Vom Bauteil zum Bauwerk» has been presented at the **8th Workshop Bau-Protect, Schutz der baulichen Infrastruktur vor außergewöhnlichen Einwirkungen** at the Bundeswehr University Munich, Germany, 13-14 November 2018.

- A **journal paper** "Enhancing Information Resilience in Disruptive Information-Centric Networks" has been published in the **IEEE Transactions on Network and Service Management** 15:2, June 2018.

- The journal article "INACHUS: Europese innovative voor Urban Search and Rescue' has been published in the Dutch fire-fighting magazine **Een-een-Twee: Tijdshrift over Brandweer en Hulverlening** 39:2, June/July 2018.

- The **journal paper** "Reliability of Collapse Simulation - comparing Finite and Applied Element Method at different levels" has been published in **Engineering Structures** 176:265-278, December 2018.

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