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Ex-post assessment of JRC Proof of concept projects 2010-2015

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Introduction

The internal JRC Proof of concept (PoC) programme was established with the aim of encouraging researchers to further develop and exploit innovative technologies arising from research activities, by way of transforming them into products, processes and services for the benefit of society at large, as well as for the market place. The programme provides financial resources for technology development activities, prototyping, and market feasibility studies. The JRC budget thus not only funds research to support all stages of the European-level policy cycle, but also allows researchers to undertake innovative work in relation to novel, original and proprietary technologies.

Selected projects are funded for a period of up to 18 months. The allowed budget per project ranges between EUR 10 000 and EUR 80 000, so that the total amount of funding available in the programme is approximately EUR 400 000 each year. The programme started in 2000 and has been repeated annually, apart from 2002 to 2004, 2006 and 2009 for a total of 68 projects funded.

PoC applications are submitted by JRC research staff in response to an annual call for proposals, and are subsequently evaluated against specific criteria. These include: (1) the degree of novelty, including the probability of generating protectable intellectual property and follow-on inventions; (2) the expected societal and/or commercial impact; and (3) the appropriateness of methods, quality and competence of personnel proposed, as well as costs relative to expected results.

Along the lines of the overarching aim of the PoC programme to exercise societal impact projects funded in the 2010-2015 period, they have to a large degree reached this goal. To a lesser degree, there has also been commercial impact by way of revenues in the guise of down payments and royalties on sales.

Societal impact is observed in the development of solutions related to different aspects of safety. This includes safeguards in the nuclear sector, safety in road and sea traffic and in the prevention of commercial trade fraud) and the important contribution to the chemical and medical sector (e.g. the characterisation of nanoparticles for consumer goods and environmental safety) and technologies or web services that are currently in use for example in the food sector or for data mining. 23 out of a total of 30 projects funded in 2010-2015 were concluded and 21 of these achieved societal impact. This means that over 70 % of the PoC projects were successful.

1. Projects funded in 2015

1.1 A 2-4 nanoparticle sorter towards an on-chip quantification and full characterisation of nanoparticles: extension to small nanoparticles

Project manager: Pascal Colpo

Duration: from July 2015 to October 2016

Amount of funding: EUR 57 500

Introduction

Due to the extensive use of engineered nanomaterials (ENMs) and the related legislation, there is an important need for new methods for exhaustive characterisation of their physicochemical properties. Among them, surface hydrophobicity is considered as a key factor to be controlled, in particular for nanomedicine applications. The basic PoC has been realised in the past months, with the tuning of surface hydrophobicity and wettability with plasma coating and poly-electrolyte self-assembling, and with the real-time detection of model nanoparticles of gold with a diameter of 70 nm and different hydrophobicity. The following work will focus on the binding kinetics analysis to enable a quantitative determination of the hydrophobicity degree and to the implementation of this work for smaller particles. The device will then be tested for ENMs i.e., full characterisation.

Novelty

Being a development of the previous year's PoC, the novelty of this project is represented by the smaller dimension of the nanoparticles involved. According to the *Recommendation on the definition of a nanomaterial* adopted by the European Commission in October 2011, a nanomaterial means 'A natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm-100 nm'. Because of this, it will be required to provide an extensive characterisation of the physicochemical properties of materials with dimensions smaller than 100 nm.

Results

The results of this project are strongly connected with those of last year's PoC, because it is an evolution of it. So, the patent filed for the preliminary idea in 2014 is still valid and refers also to this developed process including small nanoparticles, and the same logic is applicable for published as well as future publications.

Societal/commercial impact

Apart from the social and commercial impact already explained in last year's PoC, this extended its impact also to small nanoparticles, improving the capabilities and development of studies in this field.

1.2 Industrial prototyping of a synchronous AIS receiver for radiolocation of vessels

Project manager: Michele Vespe, Dario Tarchi

Duration: July 2015 to June 2016

Amount of funding: EUR 15 600

Introduction

The project concerns a flexible, compact and lightweight automatic identification system (AIS) base station/receiver tailored for radiolocation applications.

The new device will have enhanced timing and synchronisation capabilities and will be based on a flexible platform (software defined radio), allowing for compact design (weight, form factor) and further development and integration. The device represents a low-cost solution intended to facilitate the extension at regional scale of the area covered by AIS verification, a radiolocation method proposed, tested and validated in collaboration with national authorities by the JRC. The method increases the confidence in positional information as declared in the AIS message by vessels using a combination of triangulation and tracking techniques. The method, currently implanted in real time, exploits the data recorded by terrestrial national AIS networks. The new device will allow the implementation of autonomous, easily and quickly deployable additional nodes, even on mobile platforms, such as vessels of authorities in charge of maritime patrolling activities.

Novelty

The problem of protecting the AIS transponder from intentional tampering may be approached in different ways: one line of activity aims at increasing the protection against any attempt to alter the hardware (HW) or software (SW) part of the device on-board the vessel. This includes, for instance, the use of physical systems, such as array of receiving antennas to prevent the spoofing of the connected GPS system.

The JRC launched an alternative idea not requiring any kind of intervention on the AIS transponder on-board the vessel, since it operates only on the receiving AIS terrestrial base stations. It combines a classic radiolocation method, i.e. the synchronised reception of the same signal by at least three spatially separated stations, with an advanced filtering technique designed to track vessels in geodetic coordinates.

Results

The prototype was developed and concluded working with the Italian Guardia Costiera. However, the attention on this project was lost and interrupted due to many changes in the Unit. No patent was filed nor any software developed.

Societal/commercial impact

The social impact of such an instrument would have been clear initially for its importance in avoiding collision, but especially because the cooperative nature of the previous AIS and the lack of intrinsic security make it vulnerable to false or missing declarations requiring the implementation of measures increasing the trustworthiness of AIS messages.

1.3 Mobile laser scanning platform (MLSP)

Project manager: Erik Wolfart

Duration: from August 2015 to December 2016

Amount of funding: EUR 78 000

Introduction

In the context of the institutional support to the International Atomic Energy Agency (IAEA) and ENER safeguards inspectors, NUVER is currently developing a real-time indoor positioning and mapping system based on mobile 3D laser scanning (mobile laser scanning platform (MLSP)). The institutional research and development activities focus on the underlying data analysis algorithms. Funding by the PoC instrument was requested for the development of an improved user interface and interoperability with related software (e.g. GIS systems, location-aware applications).

MLSP will support safeguards inspectors in the area of design information verification (DIV) by mapping nuclear facilities and monitoring related changes over time and as enabling technology for location-aware applications during complementary access inspections.

Novelty

Whereas GPS can be used for positioning in outdoor environments, there is currently no technology available in indoor environments that would be suitable for safeguards inspector needs. Existing systems either lack the necessary position accuracy or they require that dedicated infrastructure be installed inside the facility. Furthermore, available indoor positioning systems do not provide simultaneous mapping functionality.

Results

The creation of this product generated many results, such as the project publications, and the fact that it was put on the market with good success and interest from possible clients.

The project manager and the creator and developer of the product decided to file a patent.

Another possible future development can be, based on the words of the project manager, to apply this kind of technology to additional situations. In fact, many non-nuclear applications can benefit from real-time indoor mapping and positioning systems — similar to GPS in outdoor applications. Examples include navigation and location-aware services in public buildings (e.g., shopping malls, airports); support to first responders; inspection and monitoring in civil construction and facility management.

Societal/commercial impact

MLSP can significantly improve both the efficiency and effectiveness of nuclear safeguards inspections.

Hence, the initial application of MLSP is intended to be for nuclear safeguards inspectors at IAEA and the Directorate-General for Energy. The developments proposed under the PoC funding will improve the MLSP user experience and therefore acceptance by the safeguards inspectors.

This project has also already had a commercial impact because several potential users have shown an intense and concrete interest in this product and some transactions have already made contact, and, in addition, a license agreement with a company has been signed. made, for example, two transactions with Chinese clients.

1.4 SWAP: Coexistence between high-speed networks

Project manager: Detlef Fuehrer

Duration: September 2015 to (in progress)

Amount of funding: EUR 78 000

Introduction

The proliferation of wireless systems and services and the resulting scarcity of usable radio spectrum have prompted regulatory authorities worldwide to identify the method and techniques for using spectrum more efficiently. That's why the objective of this project is to develop a PoC for a **Smart Wireless Access Point (SWAP)** to enable future growth of high-speed networks in the digital single market. SWAP will integrate several technologies to create an innovative spectrum sharing solution for mass deployment of high-speed Wi-Fi® or RLAN2 networks in 5GHz band by eliminating potential risks to societally vital Earth observation services provided through the European Copernicus3 programme.

Novelty

The objective of the mandate is to study and identify harmonised compatibility and sharing conditions for a sustainable and efficient use on a shared basis of the frequency bands 5350-5470 MHz and 5725-5925 MHz for wireless access systems (WAS), including radio local area networks (RLANs). Based on the results of the necessary coexistence studies, the operational sharing conditions for WAS/RLANs should in particular ensure that protection is guaranteed for priority systems supporting EU policies, such as intelligent transport systems (ITS) and Copernicus. The proposed system features a number of novelty functions in an innovative process which results in a unique solution for self-governance of network nodes in the 'always-on' connected society. An outstanding feature of this system is its capability to verify, with a high level of confidence, the position and time of an object exposed to Galileo signals, as well as the time an object is exposed to Sentinel's signals. An additional by-product is the capability to perform a very high-sensitivity snapshot positioning using the special feature of pilot codes of Galileo E1C signals.

Both are unique applications of Galileo to networking systems and in the context of radio-compatibility and critical infrastructure protection.

Results

There are no patents filed yet, but the intention of the project manager is to file at least two patents, one for the SWAP process and one on the design for the authenticated positioning module.

Societal/commercial impact

Political and economic benefits of the SWAP concept are manifold: it guarantees safety of high-value services of Copernicus; it creates a trustable, self-governing infrastructure for mass deployment of wireless networks in homes and offices; it promotes efficient use of radio spectrum as a natural resource; and it leverages Galileo navigation signals for a novel, large-scale application.

The goal of the project manager will be also to commercialise the solution, once all components have been concluded.

1.5 Software prototype for the Galileo ionospheric correction model

Project manager: Maria Angeles Aragon Angel, Joaquim Fortuny

Duration: January 2016 to December 2016

Amount of funding: EUR 61 950

Introduction

With the launch programme of Galileo, the European global navigation satellite system (GNSS) in full swing, the policy-makers, as well as industry, have turned their attention to ensure market readiness with satnav receivers able to use Galileo signals. This requires providing necessary standardised tools for receiver manufacturers to produce Galileo-compatible Satnav receivers.

The objective of this project is to help the industry in manufacturing Galileo-compatible receivers.

Specifically, the results of this project will help receiver manufacturers in ensuring that their receiver designs are based on correct implementation of Galileo's standard model for ionospheric error correction. This is a fundamental technical requirement for the industry to be able to deliver high-precision positioning capability expected from Galileo. In fact, even large companies with huge in-house R & D capacity need expert help in this area because the NeQuickG conformance is nearly impossible on their own. The JRC proposes to develop a reference implementation of the NeQuickG model to be made available on a portal to validate the results from third-party tools.

Novelty

While the most widely used model is probably the Klobuchar model (Klobuchar, 1986), the one established for the GPS system, the novelty that this project wants to achieve is that it will develop an independent in-house NeQuickG model that will have a flexible architecture able to be easily manipulated to support new requests in terms of support and analysis from the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, the European GNSS Agency (GSA) and receiver manufacturers.

Also, the web portal will bring several key advantages because a graphical user interface (GUI) is envisaged to allow the user to interact with NeQuickG (JRC NeQuickG Web Model) for computing and plotting slant electron density profiles and total electron content.

Results

The project manager does not have the intention to file any patent application to protect the intellectual property, but instead work is going to be published.

The future goal is to use the instruments that obtained, also thanks to the fund given by the PoC (now they have in the team the right experts to start this work), to be able to optimise the model for allowing more users to implement it with less difficulties and at lesser costs.

Societal/commercial impact

This PoC project held did not have any commercial and economical purpose, because the aim of this idea is to make Galileo more usable and accessible to users, since after this work it was really difficult and expensive to implement. So, this optimisation had this kind of goal, while the web portal will be provided for free at the Service Centre to offer them a better and more complete service. In terms of social impact, the user friendliness of Galileo offers many companies, including those in the aeronautical sector, an instrument with manifold capabilities that allows them to be increasingly precise with their receivers.

1.6 Web-based service using Newcomb-Benford's law for customs fraud detection

Project manager: Domenico Perrotta

Duration: July 2015 to (in progress)

Amount of funding: EUR 46 700

Introduction

This project proposes a web-based service that will be used by anti-fraud officers in the Member States Customs to verify the presence of data fabrication in trade declarations. The service will allow the officer to upload data from a remote PC or tablet device, using a standard internet browser and to obtain information on the possibility that specific data segments may contain manipulated declarations.

In the JRC, the service will be deployed in Web-Ariadne, an existing anti-fraud platform accessible by registered anti-fraud users. The technology transfer to the Italian Customs Agency and other selected Member States Customs will complete the project. The European Anti-fraud Office (OLAF) will be provided with access to the service through Web-Ariadne.

Novelty

The novelty of the service relies upon a new statistical methodology derived and tested on sample trade data by the proposers and the universities of Siena and Parma. The new methodology expands and enhances the applicability in anti-fraud of an intriguing law concerning the frequency distribution of leading digits in numerical datasets collected from many real-life applications, discovered independently by Newcomb (1881) and Benford (1938) and now known as Newcomb-Benford's (NB) law.

Results

There are already two publications, one on the website of the Université de Genève and one on the Journal of Business and Economics Statistics. The idea is to protect the intellectual property of the programmed evolution of this project, which is considered the ultimate goal of the project manager.

With regards to the interest shown by external actors, there was already discussion and interest for this service with some European Member States but also with countries outside Europe, such as Australia.

However, the choice of the project manager is to begin to expand the service once completed, in order to avoid technical problems and difficulties in use.

Societal/commercial impact

The real commercial impact of this project will emerge once it reaches its final stage, because the project manager wants to wait until its completion before beginning to commercialise it.

Concerning its social impact, it is very clear that it can be very useful for detecting potential frauds.

The most important thing is that this instrument must be seen as a support (and not as the unique solution of all fraud-related problems), which can provide more indications and signals in the case of analysing an ambiguous situation that is viewed as a possible fraud.

2 Projects funded in 2014

2.1 Industrial prototyping of a lightweight radar for small target detection from UAV

Project manager: Dario Tarchi

Duration: August 2014 to June 2016

Amount of funding: EUR 39 000

Introduction

Building on the experience gained with the development of radar systems, the project manager intends to design, implement and demonstrate a new lightweight radar device suitable to be flown by 'small' unmanned aerial vehicles (UAV). The proposed device will be a highly integrated version of a frequency-modulated continuous wave (FMCW) radar, aiming to minimise the system's size and weight. The idea is based on the analysis of the needs presented by end-users in the field of maritime border management, where innovative solutions are highly needed to improve the early detection and persistent tracking of small vessels.

Such a need is also fully recognised at policy level as a key operational requirement, as well as a research priority, to respond to the humanitarian crisis related to irregular migration.

Novelty

The use of UAVs equipped with various types of 'sensors' is developing very fast to address a wide range of needs in several application fields. The performance of relatively low-cost platforms has significantly increased and there is a large range of optical cameras, infrared (IR) cameras and also compact multi-spectral sensors (including gimbal) on offer, suitable for professional use. Nevertheless, for this class of UAVs there is currently no available lightweight radar sensor, even though many applications could really benefit from the use of radar-equipped UAVs. Among them, it is important to mention the potential use in the context of maritime border surveillance tasks, where the efficiency of a similar concept is well proven, but the cost and complexity of the presently available systems, often derived from systems originally designed for military applications, is a serious obstacle to systematic deployment.

Results

The project was concluded quite quickly, due to the fact that is quite simple to implement this product and it has a more demonstrative value. In fact, this creation demonstrates that for a low cost and with not too much time and effort, a tool can be created that can be very useful for managing serious problems. No patent application has yet been filed for this idea, but it has attracted interest, to the extent that publications and TV programmes were created regarding the project.

Societal/commercial impact

A tool that can help in monitoring immigration vessels that arrive daily in the far south of Italy can have a very important social impact, because of tragedies happening in the sea during this transfer.

This detection method at the beginning was achievable both with a drone and a balloon, and even if there is no a possible commercial impact for the second one (which is the one that was chosen for this project), following the words of the project manager, the first idea can be of commercial benefit in other fields in the future.

2.2 A 2-4 nanoparticle sorter towards an on-chip quantification and full characterisation of nanoparticles

Project manager: Pascal Colpo

Duration: August 2014 to September 2015

Amount of funding: EUR 61 000

Introduction

Because of the extensive use of engineered nanomaterials (ENMs) and of the related legislation, there is a great interest in new methods for an exhaustive characterisation of their physicochemical properties. Among these, hydrophobicity is an important property that is not covered by the current physical chemical characterisation techniques. Furthermore, the few existing processes dedicated to this characterisation involve a different technique, which makes it expensive and highly time consuming. The proposed study demonstrates the feasibility of an inexpensive characterisation process, thanks to a disposable chip connected to an optical reader. The detection platform is based on a patterned surface of different properties, driving the binding of ENMs according to their hydrophobicity and charge.

Novelty

Different methods are currently available for nanoparticles' (NPs) hydrophobicity characterisation. Surface adsorption assays for NP relative affinity for reference phases and hydrophobic interaction chromatography were employed to assess the surface hydrophobicity of different types of ENMs. Nevertheless, none of those methods enables a full characterisation of the different ENM properties and they all involve expensive and time-consuming analytical techniques.

Results

The outcomes of this project were very impressive. In fact, the first review was a great success because the product was very efficient and demonstrated the performances which were expected, so that after a short period (at the end of 2014) a patent was filed.

In addition, some publications were created, such as the *Journal of nanoparticles research*, and there are some still in preparation to be published.

Societal/commercial impact

The development of rapid methods for the quantification and full characterisation of NP would then be of great interest in the near future for ENMs and nanomedicine producers, as well as for users in a large range of applications providing a meaningful reduction of the cost per assay. The great success of this idea also created the possibility to

commercialise it and that is one of the tasks of the project manager, because despite its social impact, which is mainly in the medical field, it can also be used for the mass market: for example, when used for sunscreens.

2.3 Ready-to-use PCR plates for detection of genetically modified organisms

Project manager: Francesco Gatto

Duration: November 2014 to October 2016

Amount of funding: EUR 60 000

Introduction

In 2009, the JRC Molecular Biology and Genomics Unit (MBG) in its role as the European Union Reference Laboratory (EU-RL) developed the first application of a ready-to-use multi-target system, known as pre-spotted plates (PSP), with the aim to support the enforcement of EU legislation on genetically modified organisms (GMO).

In 2013/14, a pilot project on the application of this tool in routine control laboratories displayed promising performance in terms of accuracy, staff time-saving, as well as competitive cost per assay. Participating laboratories suggested some improvements to make these tools more suitable for routine activity. The aim of this feasibility study is to address these suggestions for improvements and to prove the concept of PSP integration in the quality system of testing laboratories working under accreditation. This represents the last step to make PSP available for the official control in the EU, which requires that laboratories are accredited for the methods they apply.

Novelty

Generally, for the analysis of one sample, laboratories have to perform several independent assays.

Instead, PSPs allow the preparation of a single reaction mixture and then performing a multi-target analysis in one single PCR experiment. In addition, the adoption of PSPs would automatically increase the lab testing capacity, widening the detection range of (authorised and non-authorised) GMOs.

Results

The registration of a patent was not allowed because some of the methods that are used have already been patented by someone else and, in addition, there were some publications created by the project manager that did not permit the registration of this idea.

What they are intending to do is to create a 'knowledge licence', a sort of licence agreement, for allowing a producer to deal independently and directly with the laboratories with the possibility to offer a ready-to-use product.

Societal/commercial impact

This approach would drastically reduce the laboratory workload in terms of procurement and preparation of reagents, analytical testing and the associated risk of errors.

The adoption of such a detection strategy will provide in addition to the time reduction (a reduction of 40 %) and cost benefit (approximately a 30 % reduction) — a desirable harmonisation of the analytical approach among official testing laboratories in the EU.

The project manager's future project has a potentially good commercial impact, due to the knowledge licence that they want to give to a producer, which can commercialise the product directly with the laboratories and enable them to sell the product ready to use.

3 Projects funded in 2013

3.1 Development of EMM-CollSpotting software

Project manager: Olivier Daniel Eulaerts

Duration: from November 2013, to end-2014 (CollSpotting with CERN)

Amount of funding: EUR 87 000

Introduction

CollSpotting is a tool and method using scientific publications and patents online databases to identify key players, spot and visualise the evolution of scientific collaborations for a particular technology or technological domain. The tool provides sociograms of key players and collaborations in the studied technological domain, together with a timeline feature allowing the visualisation of the collaboration's progression over time. Started as a CollSpotting with CERN, it was developed in TIM Analytics, which is a tool whose aim is to provide specific and relevant knowledge on innovation and technological development. Its objective is to offer the possibility to policy-makers to answer concrete policy needs related to innovation networks, impact evaluation of EU programmes, emerging trends and technologies, funding orientations, regional strategies and other needs related to research and innovation policy.

Novelty

The novelty of this software is represented by the fact that it provides ready-made IT solutions but also offers customised services. This IT system relies on the bridging of different datasets and on the use of text mining and computational linguistic techniques, such as semantic analysis, to treat and enrich individual data items with useful information. Datasets can then be explored from different angles by the users through various visualisations. As datasets are being updated regularly, the data visualised in TIM Technology are automatically and regularly refreshed.

Results

The development of TIM Analytics was very useful for offering a better service to the users and after its first publications, it showed a great success for the number of opportunities that it can offer.

For this kind of product, no steps to protect of intellectual property were taken, but following the words of the project manager, it could be an idea for the future.

Societal/commercial impact

The product did not have any kind of commercial impact because it was only designed to offer a good service to the community. In the coming months, a possible project will be to provide this kind of product also for private users, but always with free access — as was done with EMM.

The social impact is represented by the various solutions and customised services that the product can offer, giving users the possibility to monitor all the trends and also their growth, regarding the specific topic in which they are interested.

3.2 Improvement of the FACET software (flavourings, additives, and food contact materials exposure tool)

Project manager: Maeve Cushen, Cian O'Mahony

Duration: from 2013 November to (in progress)

Amount of funding: EUR 70 000

Introduction

The flavourings, additives, and food contact materials exposure tool (FACET) is a novel exposure tool which was created as an FP7 EU-funded research project which ran from 2008 to 2012. FACET was developed to estimate dietary exposure to flavouring, additive and food contact material substances with the aim to significantly reduce the uncertainty in the level of dietary exposure for these classes of substances in the EU population. It presents itself in the form of a desktop software application capable of performing dietary exposure assessments to these three chemical groups.

The original concept behind FACET was the creation of a food chemical exposure surveillance system, sustainable beyond the life of the project to meet the needs of EU regulatory authorities in the protection of consumer health.

Novelty

In order to maximise the impact of FACET, the prototype RTD output has now to be validated and refined to the actual user's recommendations. This important aspect has led to the development of strategies to develop an implementation and acceptability of the prototype.

The PoC instrument is a key to support the implementation from a prototype product to a fully functional one for a full-function access scale. It will also enable the development of further trainings on the tool for the various stakeholders towards the formation of a sustainability group.

Results

The project is still ongoing and is in continuous development: the most recent work has included updates to packaging data, re-implementation of the migration model (replacing the one created by FABES) and functionality changes such as non-intentionally added substance (NIAS) calculation and the allowance for commas to be regarded as decimal points in uploaded data tables.

No patent application was filed to protecting the intellectual property, however, software was developed in 2014.

Societal/commercial impact

FACET will constitute a unique tool for post-market monitoring since it reflects the real exposure of a targeted population to a food chemical, taking into account the variability of concentration and the real occurrence for each food category.

The overall impact of FACET will be evident at a number of levels including protection of the consumer, fostering innovation in the food chain, driving the scientific approach, influencing international food regulatory affairs through a focused risk assessment approach.

3.3 Integration of positioning technologies for improved accuracy

Project manager: Gianmarco Baldini

Duration: January 2014 to December 2014

Amount of funding: EUR 80 000

Introduction

Research in positioning technologies has a long history because of the unquestionable benefits in various domains, but its application in everyday life has increased enormously in recent years with the use of GNSS for road transportation, location based services (LBS) and so on. The proposal is to investigate the integration of positioning technologies to design and develop a low-cost positioning system, which has much higher accuracy in comparison to the positioning technologies mentioned above. In addition, the system should have the purpose of mitigating or compensating failures in the specific components of the integrated system, either for internal (e.g. an electronic breakdown) or external failure (e.g. lack of GNSS coverage). The final objective of the proposal is to evaluate and deploy such systems in application domains, which are of essential relevance to European policies such as intelligent transport systems or crisis management.

Novelty

The novelty of this product is represented simply by the better accuracy that it has, due to the development that was made by the project manager.

Results

The product was successfully implemented and after its implementation, there were immediately some publications uploaded to Pubsy. These publications precluded patent filing.

Today, the product is still useful for the unit and they have some future project related to it, which consists of some other publications and for automatics cars, as this is a field in which such a product can be very useful for improving safety and performance.

Societal/commercial impact

The social impact of this tool is improvement in safety in the automotive sector, because better accuracy in positioning can avoid the risk of collisions.

There was no commercial impact created by this project because it was published and it became available for everybody as a service, not with the aim of financial profit. The only relevant commercial aspect is represented by the interest of the start-up which implemented the code of the software, to begin to commercialise it, but it is a private start-up with no links to the JRC and the project manager of this PoC.

4 Projects funded in 2012

4.1 Tailoring and implementation of a prototype of Melissa

Project manager: Dario Tarchi

Duration: October 2012 to December 2013

Amount of funding: EUR 49 500

Introduction

The proposed project aims to realise an industrial prototype of a multiple input, multiple output (MIMO) radar tailored to the accurate measurement of displacements in the monitored area, such as complex man-made structure deformations or ground movements. The Institute for the Protection and Security of the Citizen (IPSC), during the past two years, has further developed its research activities in designing imaging radar devices, developing an innovative system based on a MIMO approach for maritime applications. The system has proven to have an extraordinarily high acquisition rate, which represents the key prerequisite for additional real-time applications, such as the one proposed here.

Novelty

The proposed solution is a radar imaging system which makes use of the innovative MIMO approach, which in turn dramatically decreases the system acquisition time and to eliminate the need to perform a mechanical scan. The MIMO architecture uses a highly sparse linear antenna aperture. By applying a sophisticated transmit/receive antenna element allocation (either by switching or by spatial coding), a virtual almost regular aperture of high length will be formed. In this way, an electronically steered system, without the need to mechanically move the antenna, is implemented. This innovative approach is an efficient and cost-effective solution to ensure a very high iteration rate (several frames/images per second) unmatched by other approaches. It makes new applications feasible, for example in the field of surveillance, but also allows for improved performances for traditional applications, such as deformations and displacements monitoring.

Results

The results of this project were very successful; after its implementation, it was immediately required for helping in the emergency situation caused by the Costa Concordia disaster and, although it was initially considered helpful for the first couple of months, it was used for more than two years by them and was very useful. Because of this, there was a real technology transfer, even if the product cannot be patented because the real novelty brought by this idea was the application, more than the system itself. During these two years, the product was also developed and today it is used for detecting every small movement of big structures.

Societal/commercial impact

This product demonstrates the social impact it can bring, as was shown during the emergency of the Costa Concordia. In fact, it can be very useful for improving safety, thanks to its ability to control and detect every small movement of a big structure. It can increase safety and security also in port areas, detecting every small ship that tries to enter the port illegally and also people who try to enter without authorisation.

The potential commercial impact this product can have is big, which has, already been proven by the fact that the company who is currently using it is paying royalties, but also because it can be applicable and commercialised in other fields, such as in mines.

4.2 Development and integration of Videozoom software

Project manager: Cristina Versino

Duration: November 2012 to December 2013

Amount of funding: EUR 79 768

Introduction

The proposal is to create a fully standalone software package, beginning from a collection of unchained, non-optimised software modules named Videozoom, developed by the proposers to build summaries of large surveillance streams in support of video reviews.

The target first users of Videozoom are nuclear inspectors reviewing surveillance videos in their daily work. The approach is also suited to the review of generic video surveillance streams from other domains, including process control and security.

In Videozoom, summaries are embedded in a pyramid of information layers built on the video stream content. From the top to bottom, each layer reveals progressively more details by a larger surface of summary images. The base of the pyramid gives access to the images as taken by the camera.

Novelty

Nuclear safeguards surveillance images are reviewed in batches of several thousands. In a batch, less than 0.01 % of the total number of images is expected to be safeguards-relevant. Because events are to be detected and annotated by inspectors in review reports, there is a need for tools to focus the inspector's attention on the relevant parts of the image stream.

In the current state of play, there is no tool which has the specific capability of presenting a pyramid of information layers on the image stream, as Videozoom does.

Results

The idea of filing a patent application for this product disappeared after a workshop that was held in the United States in 2014, so the project manager decided to publish their product with the idea of applying it in fields other than safeguards. However, even though AGT has shown an interest, nobody decided to implement Videozoom due to technical characteristics of the software that did not match their needs.

So today, the only collaboration and future development of this product is with the IAEA, with the product provided for free in order to add it at all their instruments for safeguards.

Societal/commercial impact

The main advantage of the system consists in considerably reducing the time spent in the video review task by helping to focus reviewer attention on relevant events.

Instead, as mentioned above, there was not a commercial impact because all potential clients who showed an interest in the product had, for different reasons, decided not to go further with this project.

The collaboration that now remains with the IAEA does not have an economic advantage but it is simply to offer a better service and is used as another instrument to improve their capabilities in safeguards.

4.3 A multi-analytical instrument for advanced single cell diagnostics

Project manager: Pascal Colpo

Duration: November 2012 to October 2013

Amount of funding: EUR 77 000

Introduction

The aim of this project is to develop an innovative instrument prototype which allows living cell analysis through the combination of three different analysis techniques in one set-up.

Living cell analysis is an important technique for many fields of application such as toxicology, drug discovery and other health-related researches. For instance, toxicology studies require live-cell imaging to monitor the response of live cells to specific external stimuli, such as pharmaceuticals, toxicants or nanoparticles, in order to give deep understanding of the mechanisms and pathways involved. Monitoring the release of several molecules from cells, e.g. cytokines (fluorescent-based tests), monitoring of oxidative stress (electrochemical measurements), changes in cell morphology and cell attachment to substrate indicative of a toxic insult (fluorescent or/and bright field imaging) are some of the analyses to be performed.

Novelty

State-of-the-art techniques give, as a whole, the required information needed for the complete cell analysis but require different instruments and different types of platforms. In consequence, complete analysis is time consuming and cost ineffective. The objective of this project is to develop an instrument allowing the performance of different types of cell analysis on a unique platform/instrument and in one step. The instrument will enable the combination of the three most valuable techniques used in cell analysis: namely fluorescence microscopy; surface plasmon resonance; and cell impedance analysis. This combination of techniques makes the instrument proposed in this project very promising as a commercial solution for a multi-analysis platform with a major advantage, when compared to conventional techniques that require one instrument for each type or analysis.

Results

Due to the existence of a similar patent application filed in 2008, it was not possible to file one for this project. However, there were some publications, and in particular a student also wrote and published a thesis regarding this project and its implementation and testing.

Societal/commercial impact

The social impact of these kinds of projects is always referred to the help that it can give to medical analysis, improvement of methods and in particular, of the effectiveness of these researches that play a key role in the development of this sector.

The initial idea was that if the project was completely successful, the next step would be to explore the market and create some commercial partnership, but this was quite difficult due to the impossibility to file a patent application, so this path was not pursued.

4.4 Generation of a detection kit for chemical pollutants using competitive binding assay for the aryl hydrocarbon receptor

Project manager: Teresa Lettieri

Duration: October 2012 to February 2014

Amount of funding: EUR 80 000

Introduction

The aim of this project is to develop an easy and rapid detection kit for detecting pollutants in industrial products and in the environment. The detection kit would be based on competitive binding assay for the aryl hydrocarbon receptor (AhR), a protein that is able to bind and be activated by a wide range of chemicals, including synthetic and environmental chemicals, as well as dietary and endogenous molecules. Some highly toxic compound such as polycyclic aromatic hydrocarbons (PAHs) and dioxins are indeed known to be high-affinity ligands for the AhR, a receptor which has gained importance since it has been suggested that it could have a role in tumorigenesis. A detection kit with these characteristics could then also be used to screen the anti-tumorigenic activity of toxic compounds.

Novelty

A further advantage of the kit resides in its conditions of use, which does not require radioactivity or expensive antibodies, making the proposed solution a sensitive yet cheap and convenient detection method.

In fact, before the start of this project there were no fast, easy and simple binding assays for the AhR.

The few currently available commercial kits to measure *in vitro* the binding to the AhR are either based on immune assay (Ah Immunoassay® kit), on cell culture (Tebu-Bio), or based on radiolabelled molecules.

The proposed solution leverages the know-how developed in the JRC related to the high-yield production of the receptor proteins in a specific functional conformation, which is one of the key elements for producing competitive binding assays.

Results

For this innovative idea, the project manager filed a patent application on 30 April 2015, after one year from the end of developing the project.

Societal/commercial impact

The social impact that such an idea can have is due to its characteristics of not being so difficult and expensive to use for monitoring the air pollutants, which is a matter always crucial for the future of our planet and our lives. Furthermore, this use is possible without any kind of radioactive elements, which is another great advantage for avoiding any kind of risk.

With regards to the commercial impact, it is the goal of the future development of this idea, which is represented by another PoC started in 2016 and that also has the aim to discover the possible exploitable market for this solution.

4.5 Development of an EMM app for Android

Project manager: Erik van der Goot

Duration: October 2012 to June 2014

Amount of funding: EUR 60 000

Introduction

Europe Media Monitor (EMM) represents a set of technologies and systems used to monitor the internet. EMM harvests and analyses information from a large number of websites in near real time and provides the results of this monitoring in different formats. EMM collects over 150 000 new news articles each day in more than 60 languages and it automatically determines what is happening to whom and where it is occurring.

The EMM website layout and capabilities can be customised to a certain extent on a per-user basis, but the system has no notion of users or user profiles. This means the technology used to provide this customisation is based on 'cookies' and is therefore rather limited. Furthermore, the layout of the website is 'fixed' i.e. the relative importance of the information is given by the ordering of the pages.

With the proliferation of mobile devices and the potential of such devices to act as an efficient delivery vehicle, the main aim of this work is to transform the EMM Newsbrief into a contemporary, mobile delivery tool. Broken loose from the limitations of browser-based design patterns, one of the main goals of this work was to revolutionise the way in which the user interacts with the mass of information provided by EMM.

Novelty

The novelty of this project is very simple and clear and is represented by the fact that there was no Android version of the app, because it was created for Apple and especially for the iPad.

So, the aim of the current project is to implement the app as developed for the iPad, on the Android platform. The app will be released for the public and we should not limit this to the Apple platform for at least two reasons: first of all, the number of users, however large, is a fraction of the total number of mobile users; and secondly, it could be construed as some sort of implicit choice in favour of the Apple platform.

Results

The mobile application was successfully created and implemented in the Android market and was also very useful because some of its particular features were also implemented in the website, due to the positive impact that they showed with the app's users.

Societal/commercial impact

The creation of this app was intended as a better service for users, so the aim of the project was not to create something for obtaining revenue, which is why this project had no commercial impact.

However, EMM is a unique set of technologies that was developed solely by the JRC and should therefore be distributed as widely as possible to the public. The free distribution of EMM as an Android application will have two main social impacts. Firstly, EMM will support internet users in dealing with the ever-increasing mass of information posted on the web. The second impact is a reputational one for the EU institutions. Citizens will have the chance to acquire for free — and host on their communication devices — a unique technology developed by the European Commission.

5 Projects funded in 2010-2011

5.1 Development of spectrally interrogated multiplexing biochips for label-free analysis of complex biological samples

Project manager: Pascal Colpo

Duration: August 2010 to July 2011

Amount of funding: EUR 72 000

Introduction

In the last 10 years, multiplexing analytical techniques gained a significant interest, since they allow the screening of the biochemical composition of complex samples. Compared to the more standardised labelled screening techniques (e.g. microarray-based fluorescence methods), label-free techniques became the most studied and interesting means for analysing complex samples. Among other label-free multiplexing techniques, surface plasmon resonance imaging (SPR-i) has acquired a predominant role in the last 3-4 years. Since the first publication on the technique (Campbell, 2007), many research groups and companies have been working on the development of SPR-based microscopes for the screening of the biochemical composition of complex samples.

Novelty

The main drawback of these techniques is that their sensitivity is at least one order of magnitude lower when compared to the non-imaging systems. This is due to an intrinsic property of any imaging system that is based on the monitoring of the intensity variations (or contrast) of the reflected light. In fact, they are vulnerable to stray light and spatial inhomogeneity in the light source, as they are based on direct intensity variations. So, the idea of this project presents a high degree of novelty because for solving this problem, the project manager would like to develop a spectrally interrogated multiplexing SPR system, which is an alternative to an imaging technique. Following our idea, on the same chip surface, many micrometric SPR sensors, with well-designed different spectral responses, will be integrated and interrogated at the same time.

Results

Unfortunately, the project did not have the expected success. There are different reasons for its lack of success: first of all, the creation of the tool proved to be more difficult than the project manager expected; and secondly, the fact that the budget was not large enough to introduce some other expert in the group, decreased the possibility of success of this creation. Maybe also the fact that it was not possible to file a patent application has played a role in this unsuccessful story, and the fact there were no publications.

Societal/commercial impact

While the possible social impact of this project was clear and referred to the fact that it is applicable and helpful in the medical field and also for some studies for the environment, the commercial purpose of the project was not very clear. The final idea maybe would have been to try to commercialise it but it was obviously for such a project, a secondary goal.

5.2 Industrial prototyping of an all-weather area surveillance device for moving target detection

Project manager: Dario Tarchi

Duration: June 2010 to December 2011

Amount of funding: EUR 80 000

Introduction

The proposed project aims to realise an industrial prototype of an all-weather area surveillance device for moving target detection in border surveillance. All-weather area surveillance systems have a major market for land and sea border control in Europe and abroad. There is also a large market for such devices in perimeter security monitoring for sensitive civilian and commercial infrastructure. So far, these needs can only be met by expensive military technology. However, due to recent technological developments, a more affordable market solution for civilian applications has become possible.

With its experience in synthetic-aperture radar (SAR) technology, the JRC's CORSA action has developed a low-cost laboratory prototype of a novel area surveillance device based on radar imaging. The prototype device is not only able to detect a moving target (e.g. a person walking or running), it can also distinguish between different types of targets (e.g. a man from an animal or a vehicle).

Novelty

The JRC prototype is a major step to overcoming the limitations of current state-of-the-art products in the civilian market. Major limitations of existing systems are the relatively low acquisition speed, the size, the need for moving parts and the cost of key components.

Whilst there are a number of systems performing SAR imaging from moving platforms such as airborne or satellites, existing ground-based systems are working according to the principle originally proposed by the JRC with the LISA instrument.

Results

Results have proven the feasibility of a low-cost solution to satisfy high-performance needs, and The JRC team has received interest from Finnish Border Guards to carry out field tests for their border surveillance applications. Unfortunately, the project did not go ahead, due to some changes to the unit that was following it, and in particular the moving of the project manager to another field, which stopped the implementation of this idea.

Societal/commercial impact

The social impact of this project, had it been successfully implemented, would have been an increase in safety and security, especially for border control but it may also have been applicable in other sectors for safety.

The commercial impact could have been realised, but the project stopped too early to begin to exploit the market potential.

5.3 Development of a portable system for contactless detection of hidden people

Project manager: Lorenzo Faggion

Duration: June 2010 to September 2011

Amount of funding: EUR 67 000

Introduction

The objective of this proposal is to develop a laboratory prototype of a portable system to detect hidden people and a scanner for commercial container based on multiple electrostatic sensors. Both system use and innovative sensing techniques are based on electrostatic field variation, and the principles have already been proven with a laboratory prototype designed and developed at the JRC.

The main application of the system is the detection of people who are illegally trying to enter a country by hiding inside commercial containers and the work will consist of reproducing and improving the capabilities of the existing laboratory system and converting it into a portable prototype.

Novelty

Several instruments and detection systems based on electrostatic fields are available in the market, such as VDE (vibrating disk electrometer) which is one of the most sensitive systems. However, despite the similar use and the good results obtained by VDE, this sensor is not suitable for an embedded application in a portable electrostatic identification system due to its specific and rather cumbersome dimensions. Considering that the number of containers daily used for transactions is much larger, more than 20 million, and all containers are supposed to be checked before departure and constantly monitored during shipping, a portable tool that detects the presence of people in real time would allow for quicker checks and more systematic investigation. Today, less than 5 % of containers are well-checked

Results

The prototype was successfully developed thanks to the PoC funding, but considering it was based on already registered principles, it was not possible to attempt to patent any aspect. In fact, the innovative techniques on which the prototype was based have already been protected by the JRC patent WO2007/071630.

Societal/commercial impact

The principal social impact that such a prototype was expected to have is in safety, in the control of hidden people in a container that can be more quick and effective, without affecting global trade.

However, another possible application is in the medical field, for the control of vital signs without directly touching the interested subject, thereby offering innovation in these kinds of controls.

The commercial impact is negligible for this project as it was not considered a possible way of creating revenues or a commercialised product.

5.4 Design and development of a pocket diffusive sampler for VOCS to POPS

Project manager: Pascual Perez Ballesta

Duration: July 2010 to July 2015

Amount of funding: EUR 70 000

Introduction

The goal of this project is to develop a diffusive sampler that can provide the maximum versatility for sampling different compounds and duration, and being able to easily modify the uptake rate by varying the diffusive resistance, without implying drastic variations or modifications in the design of the sampler. In addition, this new design aims to solve some of the main limitations found in most of the commercial diffusive samplers.

Novelty

The novelty of the present invention is represented by the capacity to provide a more versatile diffusive sampling device, also called the diffusive sampler, which allows the user to reliably collect analysis over variable periods of time in variable (fixed or mobile) locations. The sampler should also be sensitive and easy to manipulate even by less experienced users.

The relative surface for diffusion with respect to the adsorbent is greater than that for the other commercially available models. In current samplers, there is a combination of radial and axial diffusion. Nevertheless, this ratio can be modified by interchanging the diffusion body.

Furthermore, the invention also includes the use of the described diffusive sampling devices for passive air monitoring over large time ranges. The invention also encompasses the use of this device in stationary, mobile and personal exposure applications.

The invention also offers a method for air monitoring, using a diffusive sampling device as described herein, comprising the following steps: placing the device in a desired stationary or mobile location, optionally by attaching the device in a said location using a holder, starting the sampling period by removing the cover from the support body, letting adsorption occur for a determined period of time and closing the device by replacing the cover on the support body after a said time period lapsed.

Results

Due to this amount of novelties, a patent application was made on 21 May.2014, some online publications were created and a conference was held on 1 September 2014 in Madrid for the 'Dioxin Madrid 2014' event.

Societal/commercial impact

Concerning the purely commercial impact, for the moment the product has not yielded revenue, but there is a private client that, after its publication, has contacted the project manager and has expressed an interest in getting more technical and economic details about it.

Concerning the social impact, this invention can simplify all the methods of air monitoring and pollution monitoring by its characteristics of versatility and also the fact that it is immediate and easily understandable by inexperienced users.

5.5 PESTO: Portable energy storage box

Project manager: Ulrik von Estorff

Duration: July 2010 to July 2015

Amount of funding: EUR 54 000

Introduction

Due to the continuous increase in energy needs and the tremendous economic growth of developing countries, there is also more need for reliable energy storage possibilities. This is valid for very large amounts of energy, feeding the grid at peak times, as well as for small amounts in portable independent energy sources. Especially for the latter category, only a few alternatives to the conventional battery storing electric energy exist, e.g. hydrogen/fuel cell, small flying wheels, etc.

Currently, a portable energy storage unit will be proposed for flexible, non-carbon based energy charge, mainly solar/wind. This box will be able to store electrical and mechanical energy into compressed air energy (CAE). Based on a thorough market survey, experts from different fields will be proposing the design for such a box and will construct a prototype. A design company for possible exploitation is participating in the project and will deliver a virtual design for the box.

Novelty

The most common portable energy storage system is the rechargeable lead-acid battery. It is widely used in cars and other situations where mobility is required. These conventional batteries can provide constant voltage over their charge level, but have a high material toxicity, and they are normally charged through a generator in the car. The most promising mobile energy storage for electricity is the Lithium battery, which is already widely used in electronic gadgets, such as laptops, mobile phones, etc.

Currently, there is only limited experience reported about the combination of CAE and solar energy and the market for small-sized CEA storage is still in its first stages; specific prototypes have to be developed.

Results

Unfortunately, the project was not successful and has been completely dropped, without achieving the expected results and without any registration of intellectual property or publication being created.

The reason for this drop is that after a successful prototype and design study, the next step would have been the marketing of the portable energy storage box, but the

outcome of the prototype and the modelling analysis has shown that the CAE storage technology still needs more research in order to become efficient for that specific system size.

Societal/commercial impact

The project, if concluded, would have had a huge social impact, because charging the battery from wind or solar energy would minimise the CO₂ production and would maximise the independence from the grid and fossil energy; although increasing dependence upon weather conditions.

In fact, clean alternatives are needed everywhere, in the still relatively small area of portable devices compared to the energy production of global energy providers and energy used for transport.

Being vital for the social help that it could have provided, the project would not have had a commercial purpose even if concluded, because it was not considered as something to be commercialised.

5.6 Development of a novel software package for design review of safety-related systems of critical installations

Project manager: Luciano Fabbri, Sergio Contini

Duration: June 2010 to December 2011

Amount of funding: EUR 60 000

Introduction

The current proposal aims to develop a software package for implementing a novel methodology that has been fully developed by the proponents because the designs of installations which may assume hazardous behaviours, leading to accidents with unacceptable consequences, are subject to a risk analysis study to verify, inter alia, the adequacy of the safety systems.

The objective of our methodology is to support the safety engineer in reviewing the design of complex systems (e.g. nuclear, chemical installations, transport means), so as to remove both critical components (weak points), causes of accidents, as well as unreliable components, causing increasing cost. Hence, the reviewing process by means of our methodology aims to produce a uniformly protected system, assuring a predefined safety level in a cost-effective way. The methodology is based on the well-known fault tree analysis (FTA) and importance and sensitivity analysis (ISA) procedures.

Novelty

Several tools are available on the market to perform FTA as well as tools to perform ISA. Some methodologies are available to conduct ISA by using FTA, but they are based on a sequential analysis of all fault trees, describing the critical states of the system.

In general, the sequence order is selected in a subjective way and we proved it has several limitations; therefore, it does not represent the best way forward to ensure the identification of the most cost-effective design solution to improve safety. In order to overcome the limitations of the sequential approach to ISA, we have developed a novel approach based on the concurrent analysis of all relevant systems' fault trees, with the objective of identifying the best cost-effective solution(s) at a lower cost of analysis. In addition, the proposed method extends the ISA application to over-reliable system functions, if any, on which the reliability/maintainability characteristics of the involved components can be relaxed, with a resulting cost saving. The overall outcome of the analysis is a uniformly protected system, which satisfies the predefined safety goals.

Results

Despite an initial publication, work on this project was stopped due to a downsizing of the unit that was involved, which decided to focus more on the core business and therefore almost completely abandoned this idea.

Societal/commercial impact

The identification of these components may provide a contribution to cost reduction during the design phase, by still satisfying the safety goals at the same time. However, due to the fact that the project was abandoned, this social impact was not appraised and even the commercial impact of this project could not be explored.

5.7 High temperature silicone resin plastic innovation project

Project manager: Jessica Cavestro, David Ward

Duration: June 2010 to December 2011

Amount of funding: EUR 75 000

Introduction

Plastics have many applications in the appliance industry, ranging from lamp fittings in cooker hoods to oven door handles. Moreover, plastics also have many attributes that make appliances safer, cheaper and more reliable. However, they also have several drawbacks that impede further dissemination. These drawbacks can be summarised in one of the following four areas: environmental; cost; — culture; and properties. Originally, plastic was almost too good to be true, as it was durable and degraded very slowly. Even though plastics have had a remarkable impact globally, it has become increasingly obvious that there is a price to be paid for their use, namely the environment. For example, in some cases, burning plastics can release toxic fumes and originally, many manufacturing processes of plastics often created large quantities of chemical pollutants and required massive use of the Earth's limited supply of fossil fuels. Experts began to realise that the whole process of producing plastic materials and subsequent elimination or recycling could be more environmentally friendly or more sustainable than was originally thought. The new material discussed here is a stable silicone compound thermoset plastic which is much more durable than other materials (including non-plastics) and therefore has a much longer service life. A second factor is cost, both indirect (e.g. investments) and direct (raw materials). Cost has always been a big driver in domestic appliances and many innovations have fallen short of launch simply because the cost (capital investment, material costs or otherwise) was against such innovations.

Novelty

The majority of plastics (thermoplastics and thermosets) have relatively poor physical and/or chemical properties which limits their exploitation and dissemination. Most notably, plastics have low continuous operating temperatures (typically well below 250—300°C) and degrade rapidly, especially in aggressive environments. The true and real possibilities of the material are still really unknown and, from the beginning, this material has been employed solely because there were no other solutions.

Results

The development of this project would have required too many resources and working hours and for this reason, it was stopped and it did not achieve the desired goals. At the beginning, the project leaders tried to contact some external actor for starting a collaboration that could provide the possibility to have the necessary resources to continue, but nobody was available and the project was dropped.

Societal/commercial impact

This project could create opportunities from the social point of view, such as the exploration and understanding of a new material (also improving the current knowledge in this field) which can also be used in several uncharted applications such as heat

shields, firewalls and structural components including wings, medical devices, amongst others.

5.8 Development of a decision support software for evaluating data obtained by combinatorial q-PCR screening analysis (GMO)

Project manager: Laura Cengia, Marc van den Bulcke

Duration: from June 2010 to June 2012

Amount of funding: EUR 47 500

Introduction

'Knowledge support systems' can be defined as 'any device aiding at gathering, interpreting or storing data generated along a process running in an organisation'. As such, 'knowledge support systems' represent a key element in the optimal application, development and safeguarding of the information, the expertise, the technical know-how, the intellectual property and logistical assets within an organisation.

A particular kind of 'knowledge support systems' are the so-called decision support systems (DSS) which drive the process towards a final output linked to *a priori* established decision criteria (e.g. legislation).

This project will provide an informatics decision support system (iDSS), enabling the interpretation/documentation of GMO screening results. Not only will such analytical iDSS greatly streamline and facilitate enforcement efforts for compliance with the EU legislation, such iDSS moreover represents a considerable aid and money-saving tool at the laboratory level.

Novelty

The aim of this project is to develop a similar so-called iDSS incorporating most features present in the Excel DSS format, but enabling more user-friendly upgrading/modifying the DS-matrix. Also, the new iDSS should allow for more appropriate quality testing on the correct performance of the DSS algorithms.

The iDSS integrates all critical information required for optimal interpretation of the analytical results obtained by COSYPS GMO screening (such as T_m, C_t, LOD, LOQ, GMO element content, prime numbers ...). Such iDSS would represent a completely new device in data interpretation and management in the area of GMO analysis.

Results

Despite an initial publication, the work on this project has stopped (software due was concluded by FERA, an external partner) due to a downsizing of the unit that was involved, which decided to focus more on the core business and so almost completely abandoned this idea.

The head of unit also changed and the project manager stopped working at the JRC and, as a consequence, this project was no longer considered a priority because it required these efforts were not sustainable by the decreased size of the unit.

Societal/commercial impact

The iDSS, if completed, would have offered a tool that incorporates all essential information obtained in the method validation studies as a basis for deciding on the nature and the amount of GM targets present in a sample. It would have also represented a considerable reduction in cost for the user (especially in time on sample data interpretation and knowledge integration with current knowledge in QA/QC of method validation, consumables (primers, reference materials, etc.). And it guaranteed correct interpretation and documentation of the sample results, also enabling easy transfer of key analytical knowledge on the GMO analysis, as performed within the laboratory.

5.9 Cassette system for automated synthesis of Bi-213 labelled radiopharmaceuticals (nuclear)

Project manager: Alfred Morgenstern

Duration: June 2010 to September 2015

Amount of funding: EUR 50 000

Introduction

The aim of this project is to develop an industrial prototype of a single-use cassette system that allows the operation of the ITU standard Ac-225/Bi-213 radionuclide generator and the synthesis of radiopharmaceuticals labelled with the therapeutic alpha emitter Bi-213 in a fully automated manner. The system will be in compliance with good manufacturing practice (GMP) as required for the preparation of radiopharmaceuticals for use in humans. To facilitate its widespread application and to reduce costs, the system will be designed to be compatible with hardware typically available in hospital settings for synthesis and quality control of conventional radiopharmaceuticals.

Novelty

Targeted alpha therapy (TAT) is a novel and promising approach for the treatment of cancer, based on the coupling of alpha-emitting radionuclides to cancer-selective carrier molecules, such as antibodies or peptides. Due to the short range (< 0.1 mm, corresponding to 2-3 cell diameters) and the high linear energy transfer (ca. 100 keV/μm) of alpha radiation in human tissue, TAT allows to selectively deliver a highly cytotoxic radiation dose to targeted tumour cells while sparing surrounding healthy tissue. The safety and therapeutic efficacy of TAT has been investigated in a large number of pre-clinical studies and has been demonstrated in clinical studies on leukaemia, lymphoma, ovarian cancer, malignant melanoma and brain tumours.

Among the alpha-emitting radionuclides suitable for clinical application, the isotope Bi-213 is by far the most advanced. However, future clinical testing of Bi-213 radiopharmaceuticals, as well as their widespread application and commercial exploitation are requiring synthetic procedures following standardised conditions, according to GMP.

Results

Unfortunately, the project was not finalised because the commercial partner of the project manager decided not to go further and so the development (that was concluded), could not be transformed into a real prototype.

No patent application was filed and there were no publications.

Societal/commercial impact

The commercial availability of the cassette system to be developed in this project would have further increased the acceptance of using the therapeutic alpha emitter Bi-213 in hospitals and will also significantly alleviate the process for approval of future clinical trials requiring GMP conditions. Thus, the development of the system described in this project presented an important step in the widespread application and commercial exploitation of Bi-213 labelled radiopharmaceuticals as promising novel agents for the treatment of cancer. With the fact that no prototype was developed and the commercial partner decided to not continue, there was no commercial impact for this PoC project.

5.10 Nano crystalline UO₂ – industry application (nuclear)

Project manager: José Spino, Joseph Somers

Duration: from June 2010 to March 2012

Amount of funding: EUR 75 000

Introduction

High-performance ceramics with nanosized microstructures possess exceptional properties that make them especially attractive for extreme environment applications.

Furthermore, ceramics of this kind with functionalised porosities provide the technical base for a large variety of advanced technological applications, such as in highly topical issues of energy conversion and environment protection, serving as efficient supports for surface and interface processes. The JRC-ITU has launched an innovative project to manufacture nanocrystalline (nc)-UO₂ powders and bulk pellets to be tested under irradiation. The aim is to develop a fuel constituted of nc-UO₂ material which, in addition to the advantages of enhanced plasticity and gas retention, will also have the possibility to sustain larger periods of irradiation in reactors, due to faster relief of the fission damage by defects recombination at the multiple grain boundaries (GB) of the nanostructure.

Novelty

Today's nuclear fuels are produced by conversion of UF₆ to UO₂ via various processes. The product is a powder, which is pressed and sintered at high temperatures to provide the product pellet. This is then ground to the specified dimensions for loading in fuel pins for the reactor. Typically, grain sizes are in the order of 8 µm in standard fuel. Attempts are being deployed to increase the grain size by the addition of additives such as Cr₂O₃. The larger grains provide longer pathways for the fission gases and so improved fission gas retention behaviour is intended.

However, the fission gas retention behaviour of large grained fuels during power ramps have been demonstrated to be worsened. In addition, the mechanical properties of large-grain fuels are also diminished and the risks of PCMI-failures and eventual clad rupture are increased. This provokes the use of dopants to improve the grain boundary mobility, which has a not fully elucidated effect on the release of inter-granular fission gas.

Results

On this matter, a patent application was filed in 2008 by the same project manager of this PoC. This specific development of the project was published and completed with the thesis of Raquel Jovani Abril, which also followed the successive implementation of the project, which unfortunately was not so successful because the process for obtaining the industrial deployment was too laborious. In fact, at the end of Raquel's thesis work, the process was not developed further and it was not possible to obtain any technology transfer.

Societal/commercial impact

If successfully implemented, this project would have had a great impact in the development of this field, but with the difficulties in finishing and reaching the expected results, it has not had any social or commercial impact.

5.11 Automatic multilingual indexing of parliamentary documents

Project manager: Ralf Steinberger

Duration: from June 2010 to July 2011

Amount of funding: EUR 64 000

Introduction

The project proposal is to develop a software tool that automatically or semi-automatically categorises parliamentary documents according to the thousands of classes of the multilingual Eurovoc thesaurus, in all official EU languages. The software can be used by the libraries of many national parliaments in the European Union, as well as by the European Parliament (EP) and the Publications Office of the European Union (OP). In principle, it is possible to find alternative solutions to this problem, but a well-performing solution for all the 22 official EU languages would require substantial effort. The JRC-developed technology already is mature and works well, but several months of software development effort are needed to finalise the tool, so that users can install and use it without the JRC's help. Furthermore, the self-training functionality needs to be implemented.

Novelty

Automatic Eurovoc indexing can be described as an automatic multi-label document categorisation task. While document categorisation is a known application, the high number of different classes (several thousands), the highly imbalanced training sets (a few positive samples against tens of thousands of negative samples) and the fact that training documents are also multi-label, represent a significant novelty. The challenges for Eurovoc indexing are: (a) the high number of different classes; and

(b) the fact that — as each document belongs to an average of six classes — one never knows which of the many classes the word is evidence for.

Results

For this tool, software was registered, but no patent application was filed. The instrument was immediately successful and several institutions have explicitly expressed interest in this tool. The idea is also to expand this service to universities, because there were already some of them that expressed an interest in and a need for such an instrument.

Societal/commercial impact

Parliaments categorise most documents using a closed set of subject domain classes (a controlled vocabulary from a thesaurus), as this will allow them to retrieve relevant documents efficiently.

Especially in the multilingual context (e.g. in the EP or at the OP), a full text search is not an option and the thesaurus indexing is necessary. Categorising the documents with the classes of a multilingual subject domain hierarchy such as Eurovoc, allows them to retrieve any relevant document, even if it is written in a different language. These parliamentary organisations currently categorise their documents *manually*, which is both slow and expensive. This software tool will take previously manually categorised documents as input to learn to predict the most appropriate classes for new documents.

The idea was developed only for offering them a better service and not for being commercialised, no commercial impact results are generated by this project.

5.12 Production of a ready-to-use GMO screening test kit for enforcement purposes

Project manager: Antoon Lievens, Marc van den Bulcke

Duration: June 2010 to December 2011

Amount of funding: EUR 30 000

Introduction

A GMO detection approach, designated COSYPS*, based on SYBR!Green PCR screening analysis represents a novel tool facilitating the detection of material derived of commercial genetically modified (GM) crops in food/feed matrices. By applying a limited set of 11 standardised real-time polymerase chain reaction (RT-PCR) methods, a precise picture can be obtained of the GMO content present in a sample in a semi-quantitative manner. To date, the scope of the applied method would cover all commercial GM crops worldwide.

The COSYPS approach has been successfully applied to different types of food/feed products within enforcement and has been tested in about 100 proficiency tests.

The steady rate of development and diffusion of GM plants and their increasing diversification in characteristics, genes and genetic control elements poses a challenge in GMO analysis. It is expected that in the near future, the picture will be even more complex. Traditional approaches, mostly based on the sequential detection of one target at a time, or on a limited multiplexing, allowing only a few targets to be analysed at once, no longer meet the testing requirements.

Novelty

Based on the know-how gained at the EC-JRC with the development of ready-to-use real-time PCR GMO detection plates (Querci et al., 2008), it is proposed to develop a similar detection system using the COSYPS screening Q-PCR methods and including in-house produced marker plasmids as positive controls.

The project will include the following milestones:

- production of primers and reference plasmids to be used in the COSYPS;
- development of lyophilised 96-well PCR plates (500-1 000 plates);
- development of an in-house QA/QC strategy for the COSYPS ready-to-use plates;
- in-house QC on the produced COSYPS ready-to-use plates.

Results

The system that was developed thanks to this PoC is still used at the institute (which is one of the national reference labs) and the broader principles of 'GMO screening' are used in many labs throughout Europe.

Due to this success, the project manager decided to file a patent application (WO2008092866) in 2008 and several publications were commenced in that period.

Societal/commercial impact

The project aims to produce a ready-to-use test kit for GMO analysis. In this way, it is foreseen that a cost-efficient solution will be provided to the request of harmonised GMO screening methods by the enforcement laboratories, facilitating compliance with the EU legislation on the commercial use of GMO.

The use of SYBR Green detection has the advantage that without additional cost, a post-PCR confirmation of the amplified product can automatically be obtained, limiting the risks for false positives.

6 Concluding remarks

This account and analysis of all PoC projects funded throughout the years 2010-2015 has been carried out to appreciate primarily to which extent the programme has exercised societal impact and furthermore, to derive how it can be improved in order to achieve an increased effect.

More than 70 % of projects funded achieved their goals and are thus deemed as being successful. This does not in all cases mean that a spin-off company was created or that revenue was generated for the JRC by way of licensing, as the programme's main objective is not to obtain a direct economic benefit for these projects, but instead to contribute to the societal impact of research and innovation activities taking place at the JRC.

For reasons of feasibility, this report describes and discusses projects and associated results from the years 2010-2015. This period was chosen for the exercise due to the relative ease with which more detailed information can be obtained in comparison with projects concluded in earlier years; work and institutional priorities change and project managers may have left. In addition, it was deemed appropriate to select the longest uninterrupted period.

Out of a total of 30 projects, 12 have so far initiated the process to protect intellectual property, a number that is foreseen to increase as developments take place after projects have concluded, and as project managers overall have expressed the intention to do so. The expectation is that at least 20 out of the 30 projects will have protected intellectual property. The generation of intellectual property is in itself an indication of the overall significance of the programme and its potential to underpin novel and original technical solutions.

So far, three of the projects under discussion are generating revenues for the JRC, and this number is also expected to double within the next two years.

Seven projects were discontinued and the underlying common reason for a majority of them consists of changes in unit structure, including a change of head of unit. Such change in the majority of instances led to the project being abandoned, regardless of project stage. Project managers single out two main aspects relating to this: (1) a downsizing of the unit leading to a decrease in work effort that could be spent on undertaking the project; and (2) work related to the project lost priority as a result of a new head of unit. The latter issue also affected a number of already completed projects, which then would influence the degree of impact exercised by the project results. On a few occasions, real costs were higher than the estimated costs, a crucial partner for the development of the project disengaged and project completion was not attained.

In conclusion, the JRC PoC programme is largely effective and addressing the aforementioned weaknesses, its capacity to deliver impact is expected to intensify. With a closer follow-up of projects, especially those potentially affected by changes in unit work priorities and/or head of unit, the main reasons for discontinuation of sound and potentially impactful projects can be addressed.

As of 2016, independent external experts are consulted for the evaluation and selection of proposals for funding and this measure is foreseen to affect the programme positively.

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