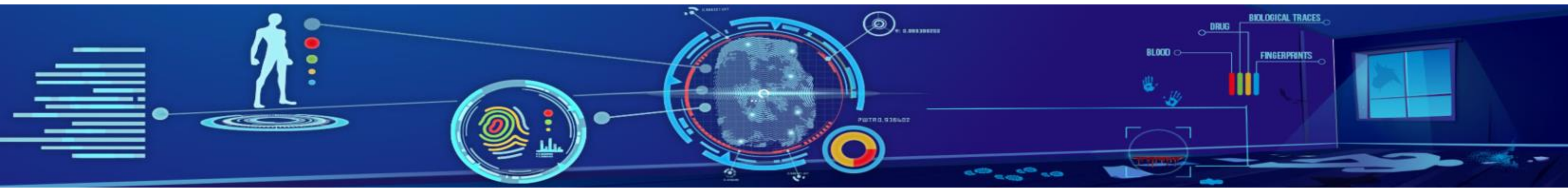


Issue No. 5, January 2023

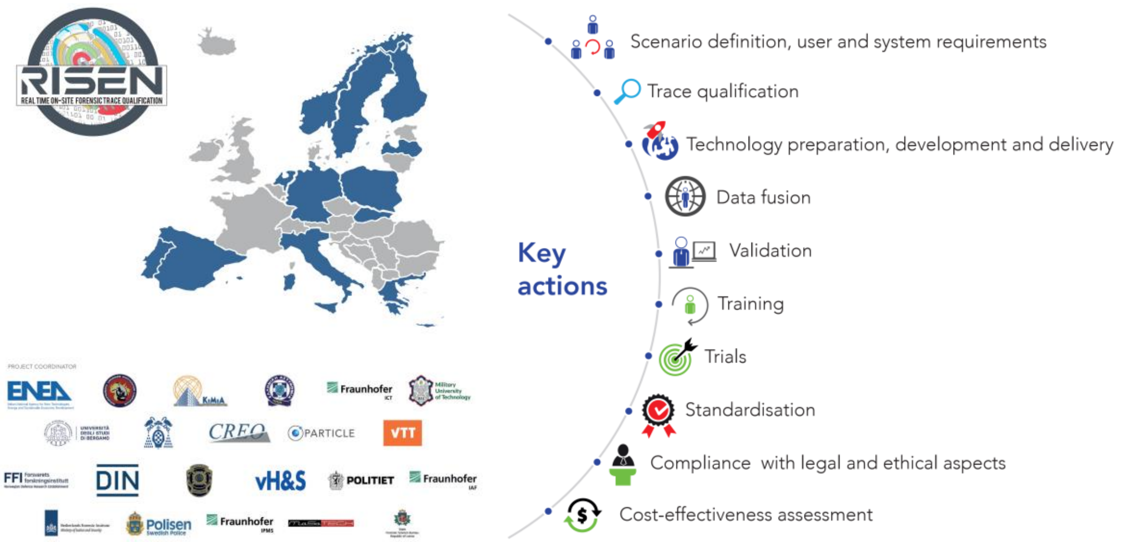
The RISEN Project

The aim of the RISEN project is to develop a set of rapid, contactless sensors and an Augmented Crime Scene Investigation system for the optimization of trace identification, classification and interpretation on site, capable of creating an interactive 3D model of the crime scene with the position and labelling of traces and the relative results of the on-site analysis.

The RISEN Consortium comprises 20 partners from 12 different European Countries that represent Research Institutes, Law Enforcement Agencies, Universities, Small and Medium Enterprises, and Standardisation Institutes. The management structure of the RISEN project is organized to meet the specific needs and scope of the challenge ahead, ensuring the involvement of all partners in the Consortium's decision-making process, whilst retaining the necessary level of autonomy allowing for fast decisions on operational and technical issues. RISEN's management structure consists of two main management boards, the Coordinator Team and the RISEN Steering Board, both supported by the Ethics Advisory Board, the Security Board and the Stakeholders and Practitioner Advisory Board.

The RISEN project is accomplished through the scientific and technological innovations stemming from 11 work packages, from scenario definition and the elicitation of user and system requirements to the preparation, development and delivery of the RISEN technologies.

Importantly, RISEN foresees an extensive training, testing and validation trials program that brings technical partners and LEAs together to improve and mature the RISEN system and enhance the EU's forensic investigation state-of-play. In the process, standardisation and full compliance with existing legal and ethical aspects support the conduct of a thorough cost-effectiveness assessment of the RISEN system, while contributing to reinforce the RISEN's trustworthiness and acceptance by LEAs across Europe.



RISEN Consortium and key actions

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 883116.

RISEN Accomplishments

RISEN is developing sensor solutions for facilitating crime scene investigation on-site. Furthermore, a 3D reconstruction and positioning tool will be used to reconstruct the crime scene and map all the sensor measurements onto this reconstruction. Sensor data fused together with the RISEN 3D Augmented Crime Scene Investigation system allows increased analysis of traces while reducing laboratory activities for further analysis, faster information exchange, and digitalization of documentation and the chain of custody. Illustration of the different modules is shown in Figure 1.

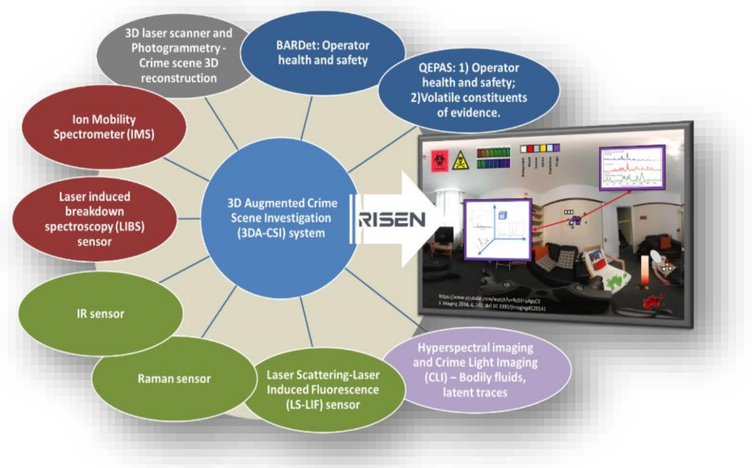


Figure 1. Illustration of the integrated RISEN modules.

In parallel with the constant development of the RISEN tools, the last six months saw the preparation and submission of four deliverables:

1. **D3.3 Testing methods and a validation plan for each analytical sensor in laboratory tests**

During WP3 the traces selected in WP2 were already studied to evaluate their analysis and forensic interpretation in laboratories, following both conventional and state of the art approaches, based on forensic operational procedures. The main objective of WE3.3 is the evaluation of the performance level during the analysis of the selected traces.

This document is based on an iterative interaction between the Trace qUalificaTion cOordination gRoup (TUTOR) and the sensor developers, resulting in guidelines for developing and validating the laboratory tests with fresh and aged samples prepared to evaluate in laboratory conditions the forensic capability of the new sensors developed by RISEN. The testing and validation plan of each sensor developed in RISEN project is presented in this deliverable. Moreover, it is reported a detailed description of each sensor, the relevant requirements for it, the testing method, and the validation plan for each new sensor, including materials, sample preparations and validation solutions, sample analysis, performance criteria.

2. **D5.2 Database for sensor performance evaluation**

This deliverable outlines the description of the testing required for laboratory validation of the RISEN sensors. The description includes requirements for the sample database for each sensor as well status of the sensors

addressing the requirements and specifications defined in deliverable D5.1. The status analysis will ensure that sensors will meet the LEA requirements collected in WP4.
The RISEN sensors compensate each other; via data fusion, more accurate data will be acquired as opposed to relying on the sensitivity of a single sensor. Moreover, the different sensors allow detection and identification of traces that are in different phases (solid, liquid, gas). The fast sensors can be used for quick scanning and screening, whilst slower sensors can be used to generate a more in-depth analysis.
The 3D reconstruction tool will handle the localization of sensor data from different traces, allowing accurate documentation and recreation of the crime scene off-site. The BARDet and QEPAS tools allow detection of hazardous materials from the air, which will indicate the end-users about possible dangers on the scene; thus, required safety measures can be made. Hyperspectral imaging can be used to gather spatially more accurate data to support point-spectroscopic measurements. On top of non-destructive tools, micro-destructive sensors can be used to facilitate material identification where relevant.
This deliverable sets targets for the detection capability of sensor in the laboratory testing phase and provides information for creating more detailed testing plan. In addition, this document provides feedback for LEAs about expected technical capabilities of the sensors for detecting specific traces in the crime scene.

3. 3DA-CSI Specifications

This document describes the technical design plans and specifications for the 3D Augmented Crime Scene Investigation (3DA-CSI) software solution that ambitions to facilitate the management, investigation and transmission of digitized information related to a crime scene.
The technology described in this document empowers a fast and accurate 3D reconstruction of the entire crime scene, allowing the collection of data from networked sensors and the positioning of all digitized information into the corresponding location in the 3D model well integrated into a case management information system, while providing secure mechanisms for managing, handling and sharing (digital) evidence across the chain of custody, namely enabling the export and import of forensics information, including cross-border data and information exchange.
The 3DA-CSI System has been designed according to the discussions and collected system requirements from the RISEN project, presented in RISEN deliverable D4.1 “RISEN system specifications and architecture” and derived from user needs as defined by the RISEN LEA partners and Stakeholders and Practitioners Board members.

4. Overview of standardization potential

The project outcomes have significant industrial relevance. The main objective of WP9 Standardization is to promote project results and transfer generated project knowledge into project-related standardization activities.
The needs for standardization within the project were identified by all project partners with regard to specific project results achieved at that time. This document focuses on showing the results of the standardization potential workshop organized by DIN.

The RISEN project and the events organised in Latvia (10-13 October 2022)

Under the excellent organisation of the State Forensic Science Bureau in Latvia, the RISEN project was involved in four different events hosted in the nice place of Jūrmala in the Hotel "Semarah Hotel Lielupe":

1. RISEN Project Meeting No.5;
2. Kick-Off Meeting for the CEN Workshop CBRNe SENSOR API – Network Protocols, Data Formats and Interfaces;
3. RISEN 3D Trials No.2;
4. Workshop on "New Forensic Capabilities" organised by SFSB.

During the PM No.5, the Work Package Leaders had the opportunity to give an update to the Consortium about the ongoing activities in each WP moreover, the agenda included different technical sessions covering several relevant aspects for the development and testing of the RISEN system.

Figure 2. Participants to the RISEN Project Meeting No. 5.

EUROPEAN COMMITTEE FOR STANDARDIZATION

The RISEN project is developing a generic SENSOR API that will be used by different RISEN sensors manufactured by different organisations. In this regard, the existing SENSOR API can be further generalised and used as a basis for a future standard, allowing any CBRNe SENSOR to connect and exchange information, in a network-enabled environment, with remote services in a uniform way.

Thus, it was proposed to develop a CWA on CBRNe SENSOR API - Network Protocols, Data Formats and Interfaces, and the kick-off meeting was held on 10 October 2022 in Jūrmala (Latvia).
More information is available at:
https://www.cencenelec.eu/news-and-events/news/2022/workshop/2022-09-08-sensor/

The 2nd RISEN trials took place successfully in one of the conference rooms in the Lielupe Hotel. During this exercise several techniques for the documentation of a crime scene were deployed:

- TLS;
- Digital cameras;

- Mobile phones equipped with Lidar;
- 360 cameras.

The purpose of this field trials was to produce a set of data collected from a mock indoor scenario (clandestine laboratory with a murder) to merge in a single 3D virtual environment. Moreover, the trials served as exercise to define the most appropriate procedures for an indoor scenario documentation.

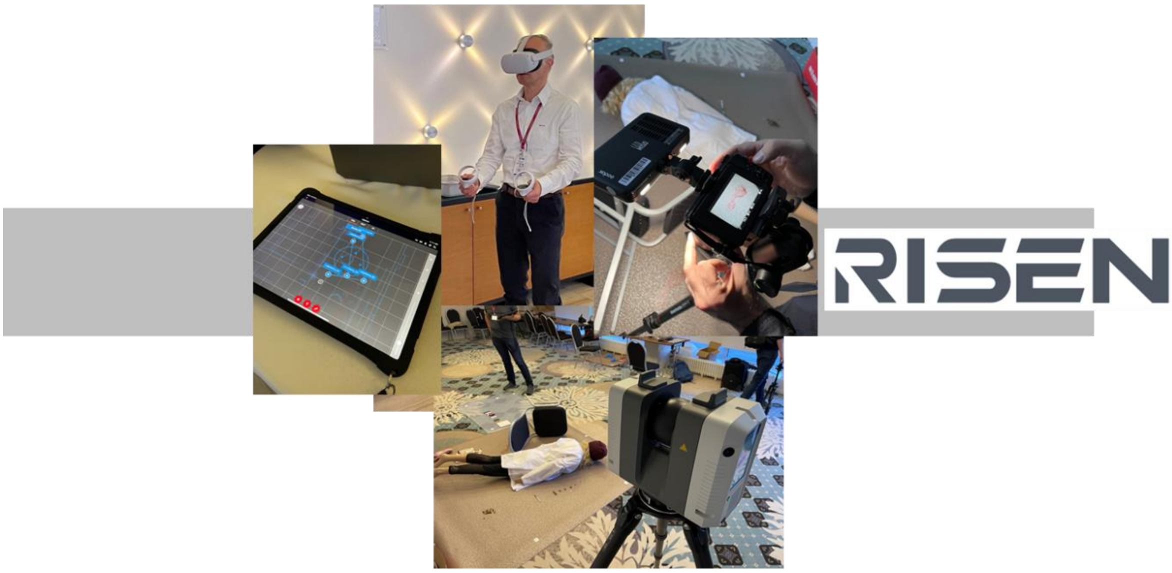


Figure 3. Some of the activities in Riga for the 2nd 3D trials.

The trials saw the participation of:

- Italian National Agency for New Technologies, Energy and Sustainable Economic Development;
- Carabinieri Scientific Investigation Group;
- Technical Research Centre of Finland Ltd;
- The National Criminal Investigation Service;
- Swedish Police Authority;
- Latvian police.

Figure 4. The 3D team in Riga for the 2nd trials.

The trials in Latvia were also the first opportunity to meet in person the members of the RISEN Stakeholder & Practitioner board. In fact, the representatives of the following institutions attended the trials and the Workshop:

- Finnish National Bureau of Investigation;
- National Police Chiefs' Council-Forensic Capability Network;
- Hungarian Institute for Forensic Sciences;
- Police Service of Northern Ireland;
- Swiss Cantonal Police (Ticino).

The SPB members will provide a support in the definition of harmonised procedures for 3D documentation of a crime scene.

The State Forensic Science Bureau of Latvia in cooperation with the Latvian Court Administration of Latvia held a workshop “New Forensic Capabilities” on 13 October 2022 in Jūrmala, Latvia, within the project “Justice for Growth” funded by the European Social Fund.

Representatives from the Latvian law enforcement institutions – State Police Criminalistics Department, Prosecutors office, courts, Corruption Prevention and Combating Bureau, Road Traffic Crime Investigation Bureau, State Forensic Science Bureau and Lithuanian law enforcement - Forensic Science Centre of Lithuania, Lithuanian Police Forensic Science Centre, and Estonian Forensic Science Institute attended the workshop.

Figure 5. Speakers at the “New Forensic Capabilities” workshop.

Roberto Chirico from ENEA (Italy), Giuliano Iacobellis from RaCIS (Italy) and Johannes Peltola from VTT (Finland) covered new possibilities of crime scene documentation in 3d environment and introduced the RISEN project. Francesco Saverio Romolo from UniBg (Italy) covered the topic of a dangerous crime scene and contribution of analytical chemistry.

Introduction to the RISEN Tools (Part 4)

The planned **3D Visualisation (3DV) Component** provides a graphical user interface for the investigators for examination and updating the crime scene data in an intuitive and immersive way. The visualisation layer includes functionalities for data visualisation using high-resolution displays, augmented reality technologies and virtual reality headsets.

The forensics data collected using the sensor-based analytical tools is overlaid on the 3D model of the crime scene, which can be visualised, examined and updated using the 3D Visualisation Component. The 3DV Component provides investigators with capabilities to visualise and examine the forensics data including results from data fusion, and visualising spatial correlations, allowing inspection of each step of the process and reverting it when needed.

The created 3D model can be manipulated using the 3DV Component and it can for example provide a downscaled model for visualisation on different end-user devices and usage contexts. The visualisation has different hierarchy levels for examining the crime scene, allowing for viewing the sensor data and the classification results as well as showing the relationships of different data by sensor fusion and spatial correlation visualization. The 3D model can be viewed remotely, facilitating off-the-scene personnel interaction.

The 3DV Component can be also used to display alerts and notifications to the users. In addition, it contains tools for bookmarking specific views and adding manually data as well as labels to ease the 3D model usage and forensic data analysis.

Figure 6 presents an example of the interactive and annotated 3D view. An image annotation is located in the middle of the view, which correspons to details located on the floor of the room. Sensor information will be visualised in a similar manner as image annotations.

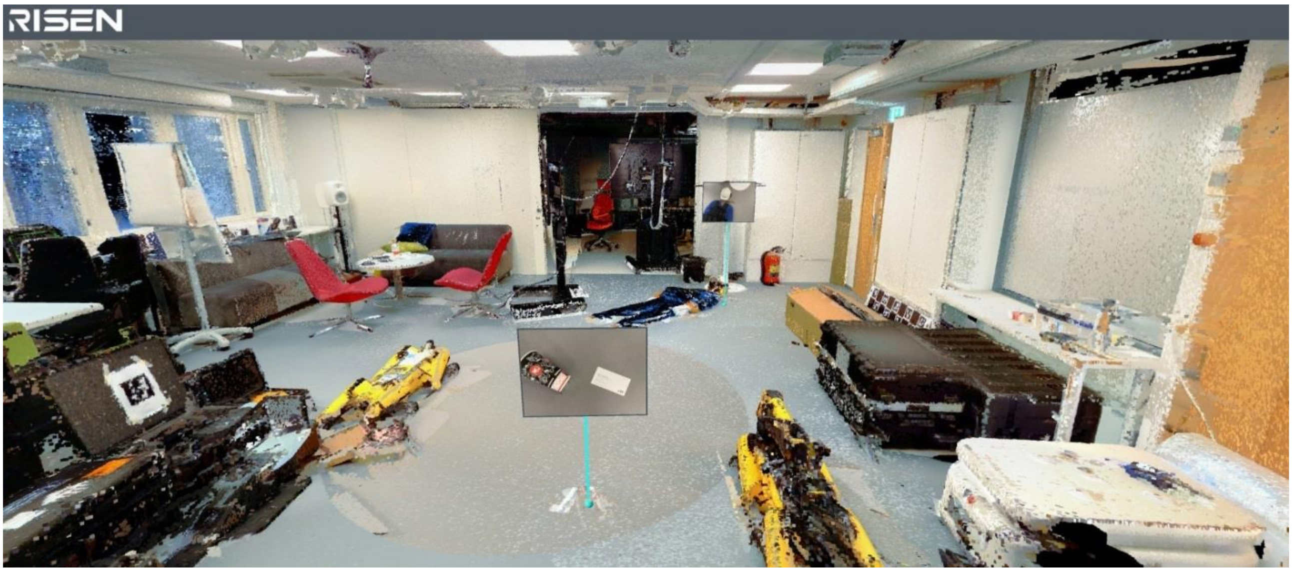


Figure 6. 3D visualisation of an image annotation.

RISEN project is researching methods for the automatic positioning of the scanning sensor results in a 3D model. Developed solution deploy a panorama camera mounted on the same tripod together with the forensic sensors and use the panorama camera to localize the tripod relatively to the 3D model using the colour information. The panorama camera offers 360-degree field of view to of the environment and thus, is less sensitive to e.g., symmetric or repetitive structures, plain walls, and changes in the environment (e.g., moved furniture) when compared to the traditional perspective cameras with much narrower field of view. The method consists of two steps:

1. Finding initial candidate poses for each panorama image.
2. Ranking the N most promising initial candidate poses per panorama image based on optimization scheme, where the discrepancy between the panorama image pixels and corresponding point cloud colour values is minimized.

The optimized camera pose with the smallest loss value is then chosen as the result as depicted in the example Figure 7.

As both the coloured point cloud produced by the 3D laser scanning system and panorama images taken with e.g., Ricoh Theta camera are gravity aligned, we have modified the optimization scheme to adjust only position, and yaw angle. Moreover, the initialization method based on the colour histogram fails sometimes i.e., it is not able to provide close enough candidate poses for the optimization phase. Therefore, we are investigating alternative methods including the use of global feature descriptors.

Figure 7. Panorama image (above) and corresponding virtual image (below) rendered from the best matching pose.

Other RISEN dissemination activities

Additively Manufactured Detection Module with Integrated Tuning Fork for Enhanced Photo-Acoustic Spectroscopy

Abstract

Starting from Quartz-Enhanced Photo-Acoustic Spectroscopy (QEPAS), we have explored the potential of a tightly linked method of gas/vapor sensing, from now on referred to as TuningFork-Enhanced Photo Acoustic Spectroscopy (TFEPAS). TFEPAS utilizes a non-piezoelectric metal or dielectric tuning fork to transduce the photoacoustic excitation and an optical interferometric readout to measure the amplitude of the tuning fork vibration. In particular, we have devised a solution based on Additive Manufacturing (AM) for the Absorption Detection Module (ADM). The novelty of our solution is that the ADM is entirely built monolithically by Micro-Metal Laser Sintering (MMLS) or other AM techniques to achieve easier and more cost-effective customization, extreme miniaturization of internal volumes, automatic alignment of the tuning fork with the acoustic micro-resonators, and operation at high temperature. This paper reports on preliminary experimental results achieved with ammonia at parts-per-million concentration in nitrogen to demonstrate the feasibility of the proposed solution. Prospectively, the proposed TFEPAS solution appears particularly suited for hyphenation to micro-Gas Chromatography and for the analysis of complex solid and liquid traces samples, including compounds with low volatility such as illicit drugs, explosives, and persistent chemical warfare agents.

sensors

Viola, R.; Liberatore, N.; Mengali, S. Additively Manufactured Detection Module with Integrated Tuning Fork for Enhanced Photo-Acoustic Spectroscopy. Sensors 2022, 22, 7193. https://doi.org/10.3390/s22197193

https://www.mdpi.com/1424-8220/22/19/7193

Compact GC-QEPAS for On-Site Analysis of Chemical Threats

Abstract

This paper reports on a compact, portable, and selective chemical sensor for hazardous vapors at trace levels, which is under development and validation within the EU project H2020 “RISEN”. Starting from the prototype developed for a previous EU project, here, we implemented an updated two-stage purge and trap vapor pre-concentration system, a more compact MEMS- based fast gas-chromatographic separation module (Compact-GC), a new miniaturized quartz-enhanced photoacoustic spectroscopy (QEPAS) detector, and a new compact laser source. The system provides two-dimensional selectivity combining GC retention time and QEPAS spectral information and was specifically designed to be rugged, portable, suitable for on-site analysis of a crime scene, with accurate response in few minutes and in the presence of strong chemical background. The main upgrades of the sensor components and functional modules will be presented in detail, and test results with VOCs, simulants of hazardous chemical agents, and drug precursors will be reported and discussed.

Liberatore, N.; Viola, R.; Mengali, S.; Masini, L.; Zardi, F.; Elmi, I.; Zampolli, S. Compact GC-QEPAS for On-Site Analysis of Chemical Threats. Sensors 2023, 23, 270. https://doi.org/10.3390/s23010270

https://www.mdpi.com/1424-8220/23/1/270

Differentiation of blood and environmental interfering stains on substrates by Chemometrics-Assisted ATR FTIR spectroscopy

Abstract

Blood is the most common and relevant bodily fluid that can be found in crime scenes. It is critical to correctly identify it, and to be able to differentiate it from other substances that may also appear at the crime scene. In this work, several stains of blood, chocolate, ketchup, and tomato sauce on five different substrates (plywood, metal, gauze, denim, and glass) were analysed by ATR FTIR spectroscopy assisted with orthogonal partial least square-discriminant analysis (OPLS-DA) models. It was possible to differentiate blood from the environmental interfering substances independently of the substrate they were on, and to differentiate bloodstains according to the substrate they were deposited on. These results represent a proof-of-concept that open new horizons to differentiate bloodstains from other interfering substances on common substrates present in crime scenes.

Cano-Trujillo, C.; García-Ruiz, C.; Ortega-Ojeda, F.-E.; Montalvo, G. Differentiation of blood and environmental interfering stains on substrates by chemometrics-assisted ATR FTIR spectroscopy. Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 2023, 292, 122409.

https://doi.org/10.1016/j.saa.2023.122409

IX Iberian Meeting on Colloids and Interfaces (RICI9) Congress (July 10th-13th 2022)

Organised by the Specialized Group on Colloids and Interfaces (GECI) of the Spanish Royal Society of Chemistry (RSEQ) and the Spanish Royal Society of Physics (RSEF) and the Colloids, Polymers and Interfaces Group of the Portuguese Chemical Society (SPQ), the congress took place in Santiago de Compostela, Spain. During the congress, UAH presented the poster titled *"ATR-FTIR spectroscopy assisted by chemometrics applied to forensic chemistry: bodily fluid differentiation"* (Figure 8).

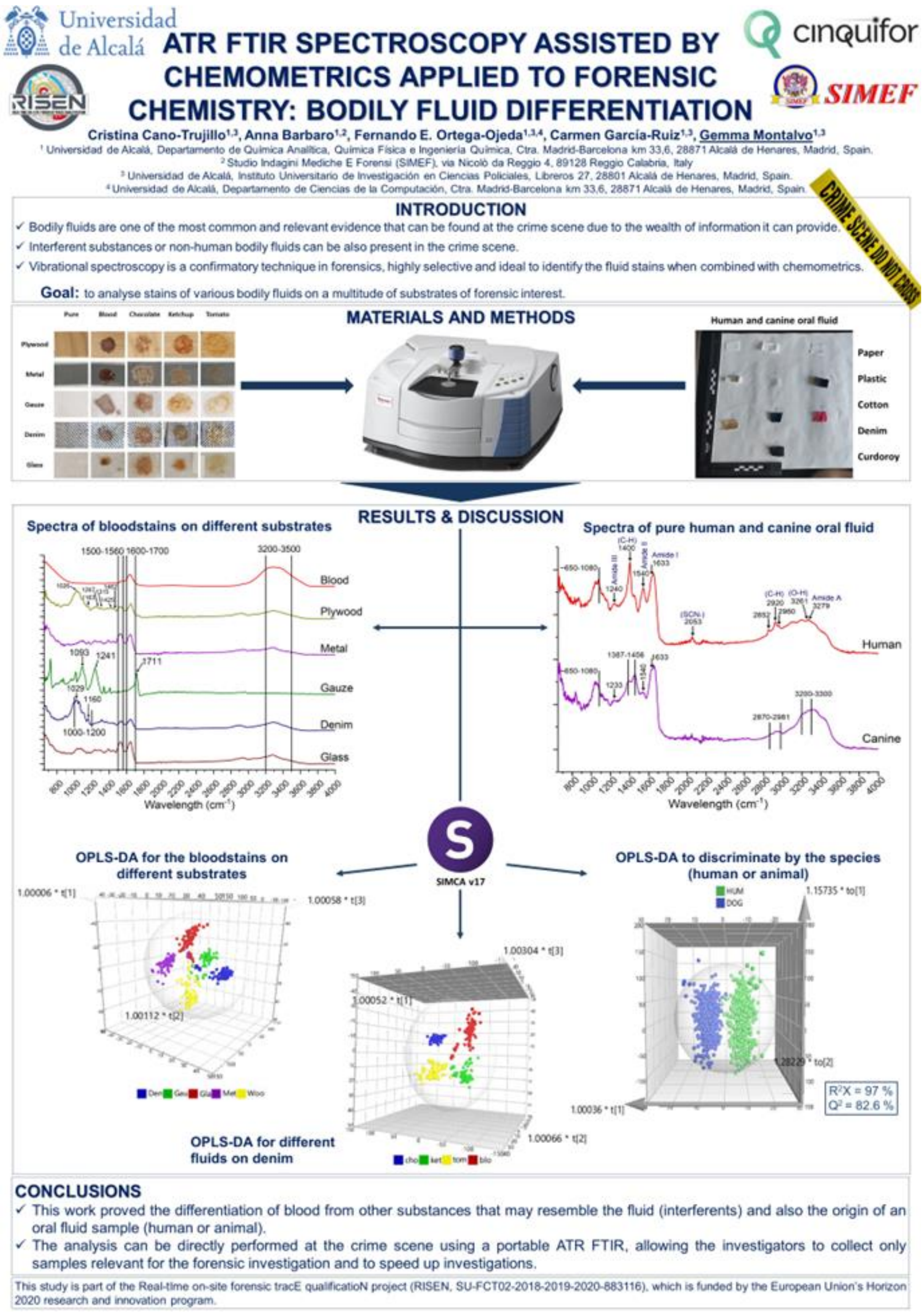


Figure 8. ATR-FTIR spectroscopy assisted by chemometrics applied to forensic chemistry: bodily fluid differentiation.

XXII Science Week - "CSI ALCALÁ"

From 10th to 11th of November 2022, this edition was celebrated in UAH Sciences Faculty, Alcalá de Henares (Madrid), with a total duration of 8h spread over the two days. Attendees were secondary and high school students from various institutes and schools of Spain. In this edition, the dissemination activity reached a total attendance of 210 students (Figure 9 and 10).

Figure 9. Dr. Anna Barbaro and Mrs. Cristina Cano inspecting the crime scene recreation with some of the attendees in XXII Science Week dissemination activity "CSI ALCALÁ" organized by CINQUIFOR group and celebrated in University of Alcalá.

Figure 10. *Mrs. Cristina Cano with a UAH undergraduate student teaching the attendees some of the biological fluids and interferents materials and their Raman and FTIR spectra in the XXII Science Week dissemination activity "CSI ALCALÁ" organized by CINQUIFOR group and celebrated in University of Alcalá.*

FACTS AND FIGURES

Total Budget: € 6'995'876.25
Start date: July 1st, 2020
Duration: 54 months

CONTACTS

Project Coordinator:
Roberto Chirico, Senior scientist
Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA)
Diagnostic and Metrology Laboratory
Via Enrico Fermi, 45
00044 Frascati (Rome)-Italy

Phone: +39 06 94001
Mail: risen@enea.it

RISEN welcomes inquiries from press and media.

Press office ENEA
http://www.enea.it/it/Stampa

For any information please contact:
Mail: risen@enea.it

The RISEN Project is a collaboration between: