700829 — 3D-Forensics/FTI — H2020-FTIPilot-2015-1

3D-Forensics/FTI – Mobile high-resolution 3D-Scanner and 3D data analysis for forensic evidence fast track to innovation

D4.1 Report on familiarisation and first pilot testing

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* **PU** = Public

PP = Restricted to other programme participants (including the Commission Services).

RE = Restricted to a group specified by the consortium (including the Commission Services).

CO = Confidential, only for members of the consortium (including the Commission Services).

SUMMARY: This report documents the results of the *Task 4200 Prototype familiarisation testing* and first results of the *Task 4400 Pilot testing*.

This report includes information on how the familiarisation and first pilot testing was implemented by the EETG and the consortium. The EETG members' feedback on the 3D-Forensics system is given in summary as are the measures being taken with the goal to incorporate their needs and preferences in the advanced prototypes.

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Contents

1 Introduction

The work package *WP4 Piloting/Test Bed/Validation* covers the testing and validation activities by the consortium partners and the External Expert Tester Group (EETG). The activities are split into four tasks.

In the first phase in workpackage 4, the EETG members were introduced to the new technology. Hereby they performed familiarisation as well as first pilot testing using the initial prototype system and provided feedback on the 3D-Forensics prototype system. This report documents the results of this first testing phase, specifically scheduled in the tasks *Task 4200 Prototype familiarisation testing* and *Task 4400 Pilot testing*.

This report describes in chapter 2 the implementation of the first testing phase and presents the members of the EETG involved in that phase. In chapter 3 the feedback of the EETG is summarized.

2 Familiarisation and first pilot testing

2.1 Implementation of the testing

3D-Forensics / FTI is supported by an External Expert Tester Group (EETG). In preparation of the project six specific end users confirmed by letter their support to the project and willingness to be a member of the EETG. Five of these users were to date involved in the familiarisation and first pilot testing. The involvement followed roughly the following stages:

Table 1: Stages of involvement of the EETG member

Step	Duration
1) Introduction meeting: In-depth presentation of the project objectives and work plan; discussion of end user priorities and resources available to support project	0.5 - 1 day meeting
2) Training workshop: In-depth training in the handling of the 3D-Scanner and analysis software	1 – 1.5 day meeting
3) Testing: Autonomous familiarisation and first pilot testing by the end users	ca. 2-4 months loan period for 3D-Scanner unlimited loan of analysis software
4) Feedback collection: Collection of feedback through written template, per e-mail and / or telephone calls; discussions in previous meetings and workshops	unlimited

*For the end user EFSI the stages 1) and 2) were summarized in one meeting.

Fig. 1: Training Workshop in Jena

The consortium was open to any feedback from the EETG. As assistance for the users a feedback template was prepared. The feedback template contains suggested areas to test and a template to protocol specific test setups and results.

2.2 External Expert Tester Group (EETG)

The following tables contain information about each of the organisations that committed to being members of the EETG when the project was prepared, how the stages of involvement (see Table 1) were realized and some sample results from each testing stage.

EE2	**Yorkshire and The Humber Police**	**WYP**	**UK**	POLICING YORKSHIRE & THE HUMBER Joint thinking, joint working

Brief Description of organisation:

Yorkshire and The Humber Police is a regional collaboration of four forces in the Yorkshire and Humber region (Humberside, South Yorkshire, North Yorkshire and West Yorkshire Police). The collaboration is on a range of policing issues to deliver capacity and capability in specialist and strategic areas of policing. The regional teams also support local teams to tackle serious and organised cross-border criminality, improve confidence as well as delivering a value for money service for the benefit of the region.

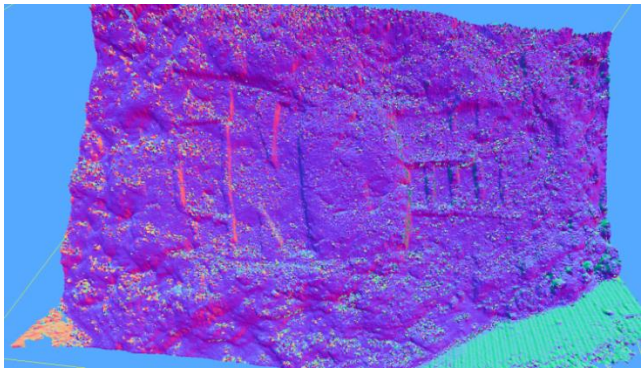
Website: http://www.westyorkshire.police.uk/about-us/department-profiles/regional-collaboration
http://www.northyorkshire.police.uk/3514

Involvement in 3D-Forensics/FTI (following Table 1):

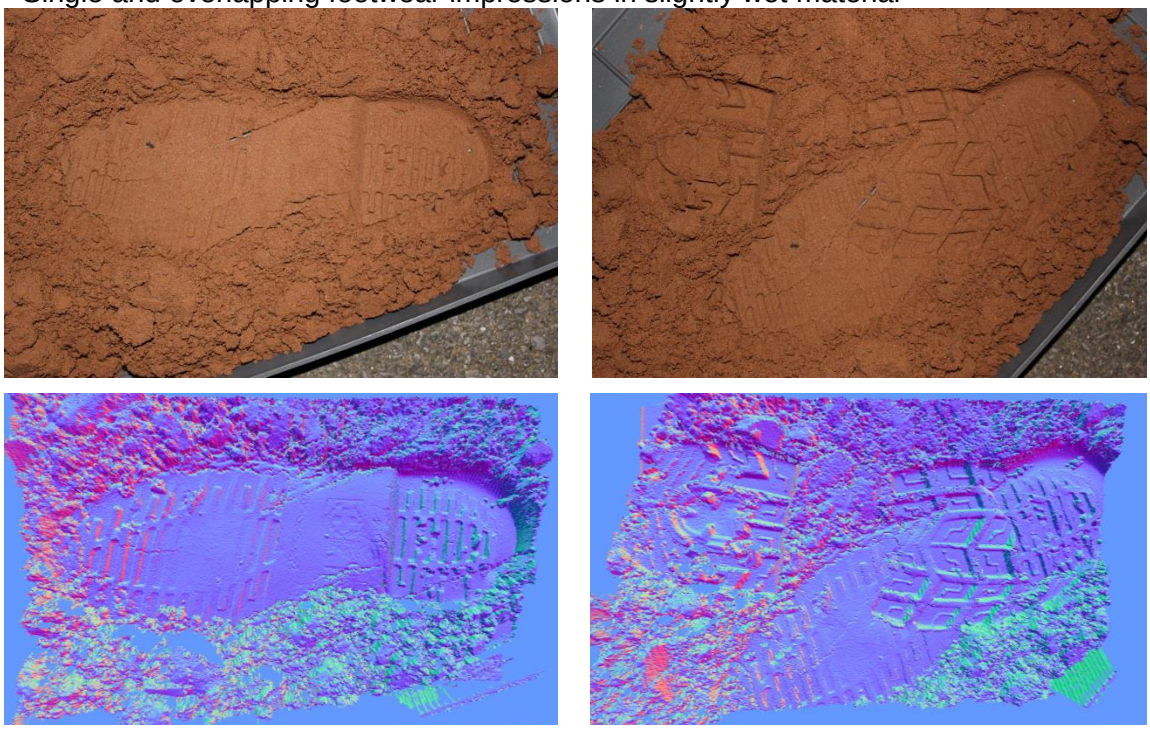
1) 27/09/2016 | 6 attendees
2) 01/03/2017 | 6 attendees
3) 01/03/2017 – 30/05/2017
   At least 2 CSI-officers, 1 forensic examiner
4) 05/06/2017 – Feedback on 3D-Scanner through e-mail and feedback template

Sample results:

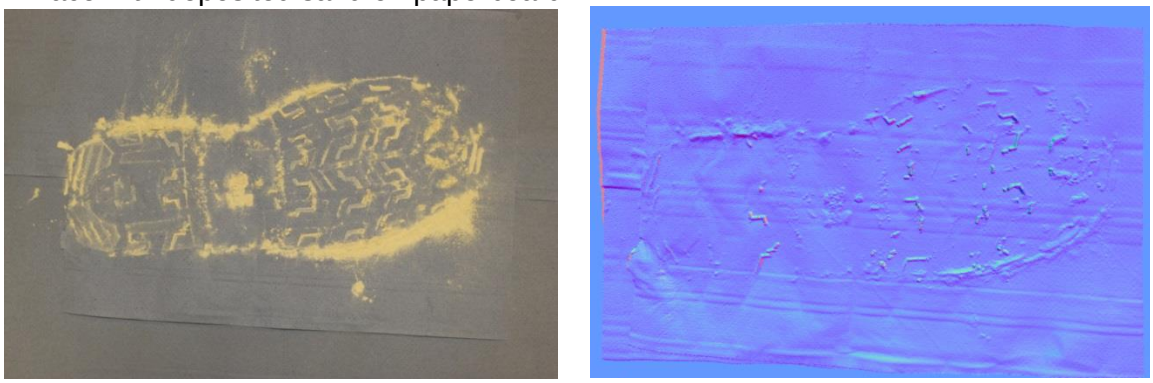
- Very wet surface



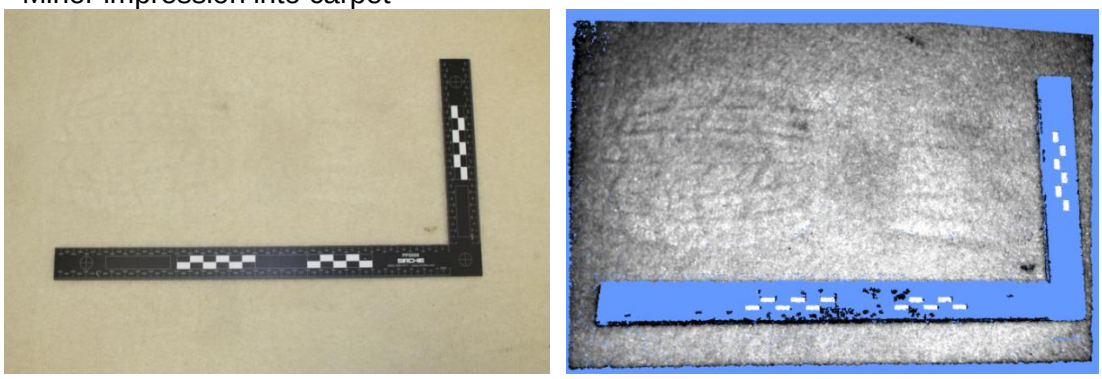
- Single and overlapping footwear impressions in slightly wet material



- Trace with deposited sand on paperboard

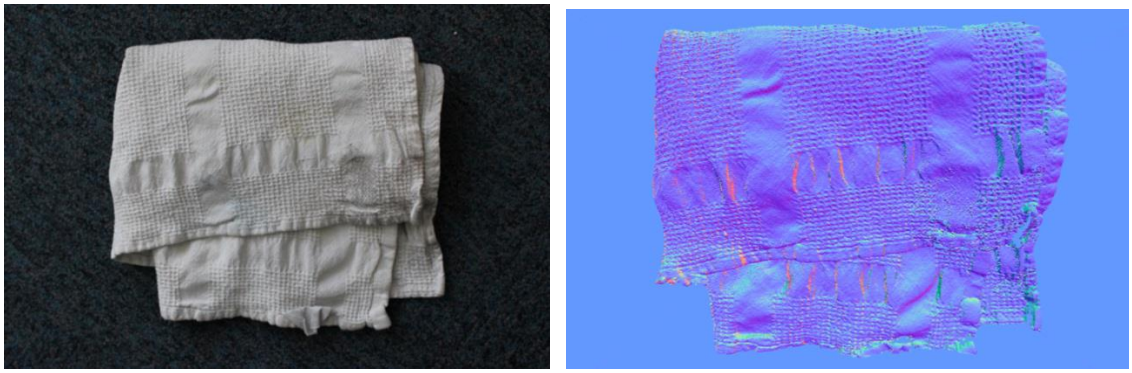


- Minor impression into carpet

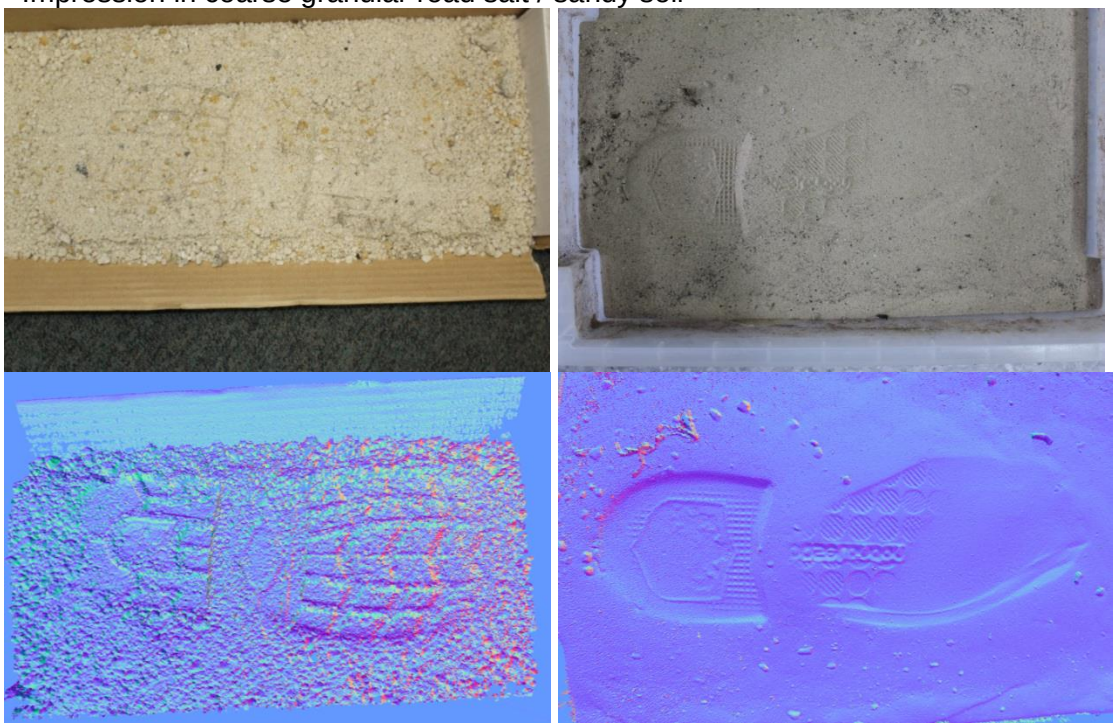


Default

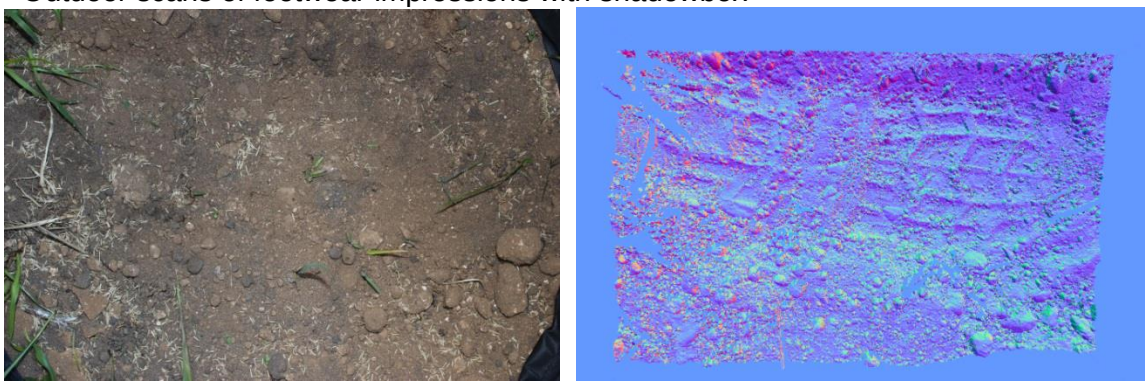
- Traces on textile



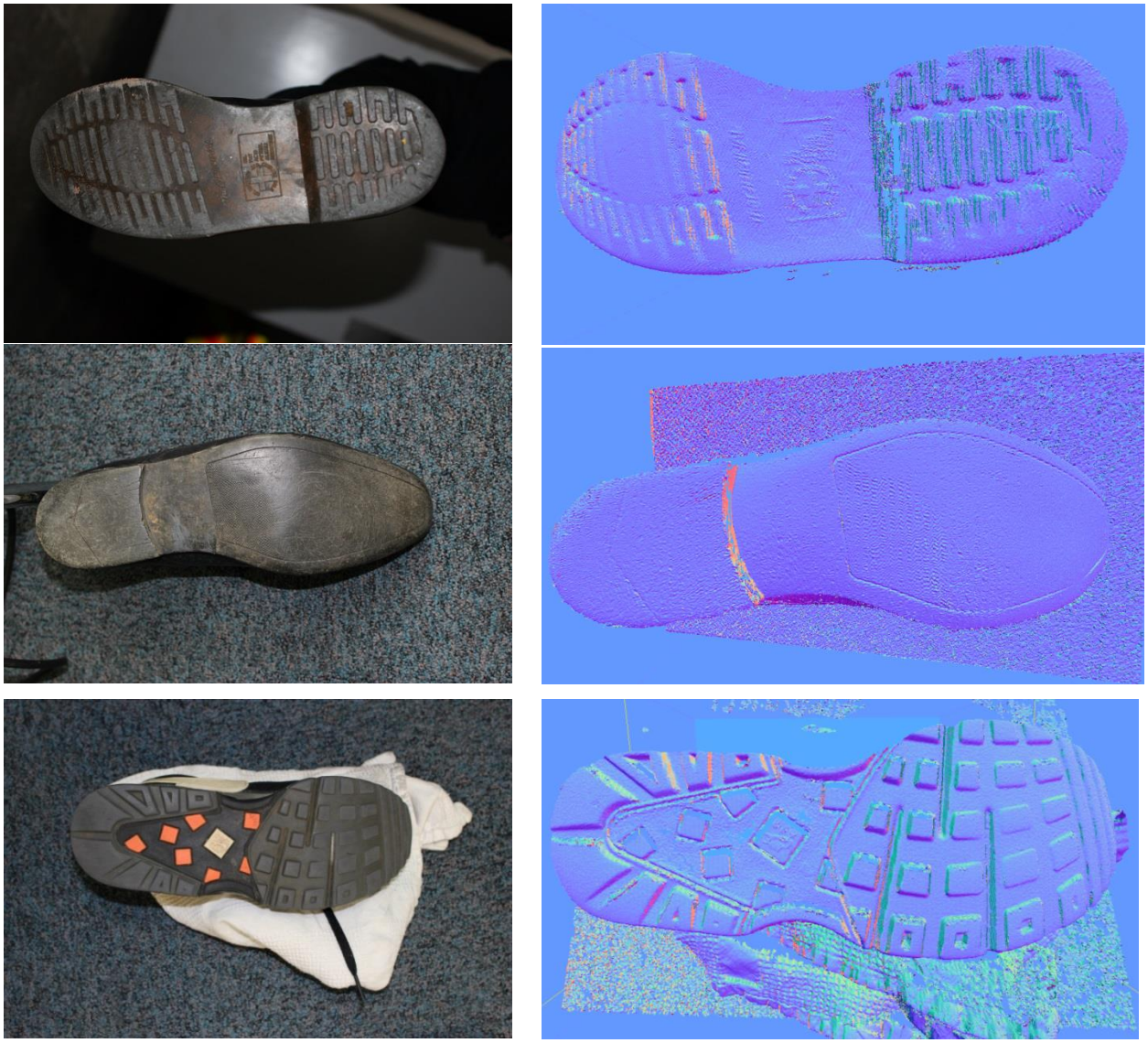
- Impression in coarse granular road salt / sandy soil



- Outdoor scans of footwear impressions with shadowbox



- Different shoe soles used to make the traces



EE3	**Scottish Police Authority – Forensic Services**	**SPA**	**UK**	SCOTTISH POLICE AUTHORITY

Brief Description of organisation:

The Scottish Police Authority (SPA) was established under the Police and Fire Reform (Scotland) Act 2012 to ensure that the people of Scotland receive the best policing possible. The Forensic Services in Scotland is set up to support Police Scotland to carry out operational policing. Forensic Services brings together forensic and fingerprint capability and Scene of Crime Officers, placing forensic services in Scotland at the forefront of evidence capture and analysis. This approach allows the police to provide, for the first time, a fully integrated national service from 'crime scene through to court'.

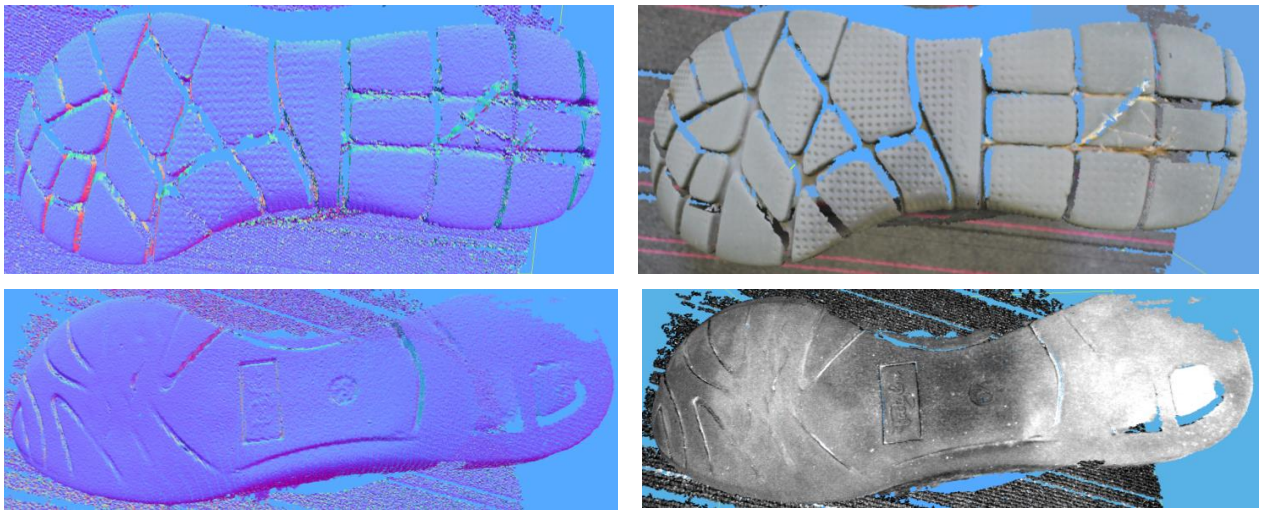
Website: http://www.spa.police.uk/forensic-services/

Involvement in 3D-Forensics/FTI (following Table 1):

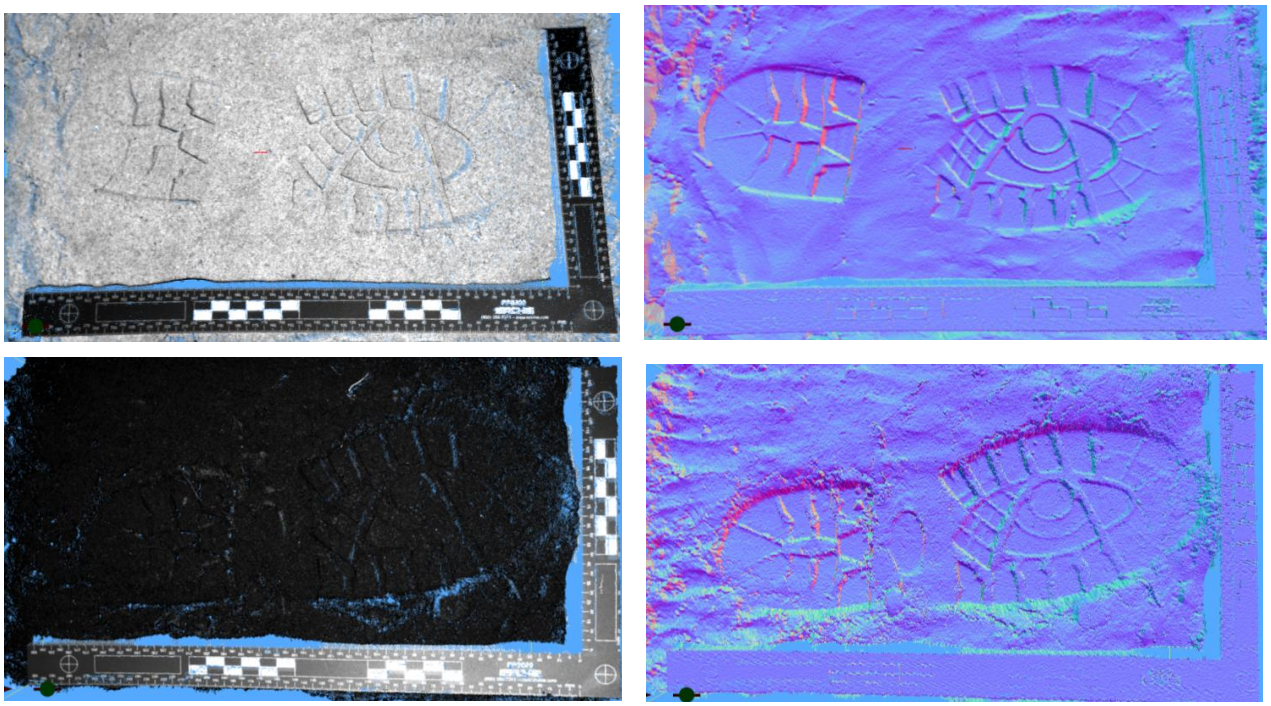
1) 28/09/2016 | 4 attendees
2) 28/02/2017 | 5 attendees
3) 28/02/2017 – 23/08/2017
   At least 2 CSI-officers, 2 forensic examiners
4) 25/05/2017 – Feedback on 3D-Scanner through e-mail

Sample results:

- Footwear soles (inclination shading and coloured by external camera image)



- Footwear impression in soil including a scale (default/grey and inclination shading)



EE4	**Landeskriminalamt Mecklenburg-Vorpommern**	**MV**	**DE**	

Brief Description of organisation:

The State Office of Criminal Investigations from the federal state of Mecklenburg-Western Pomerania has its headquarter in Rampe nearby Schwerin. The department "Kriminalwissenschaft und –technik" (forensic research and technology) is contributing 3D-Forensics/FTI.

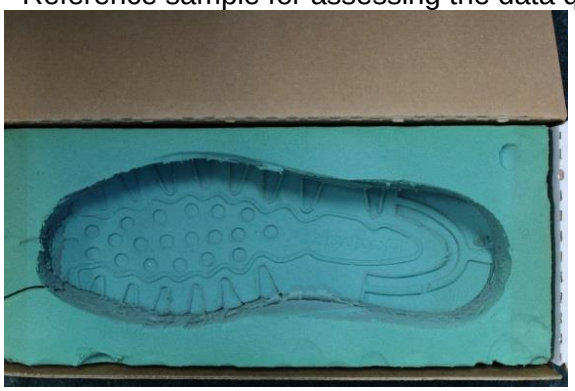
Website: http://www.polizei.mvnet.de/

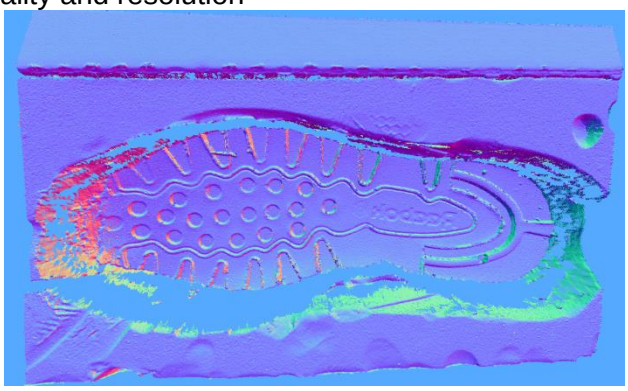
Involvement in 3D-Forensics/FTI (following Table 1):

1) 13/09/2016 | 10 attendees
2) 26-27/10/2016 | 6 attendees
3) 15/11/2016 – 31/03/2017
   several CSI in different field offices, 2 forensic examiners
4) 15/05/2017 – Feedback on 3D-Scanner through e-mail and feedback template

Sample results:

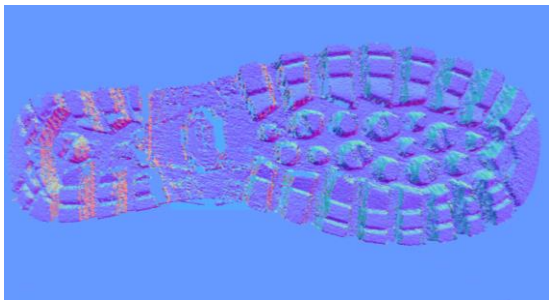
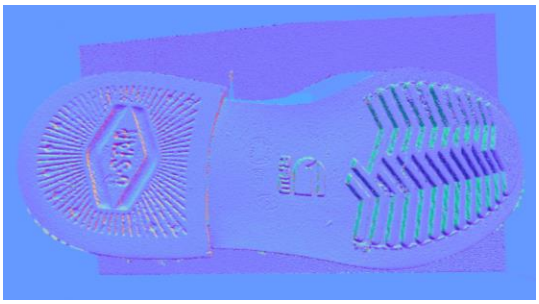
- Reference sample for assessing the data quality and resolution





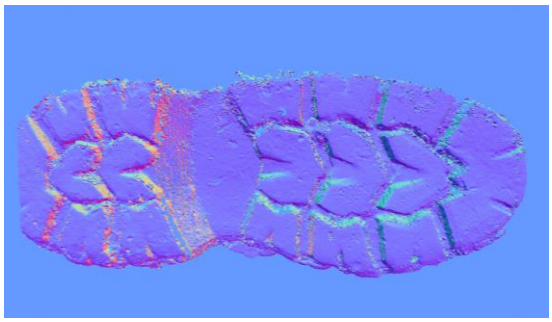
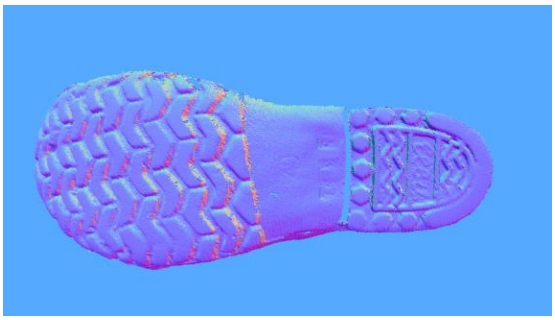
- Different shoes used for testing



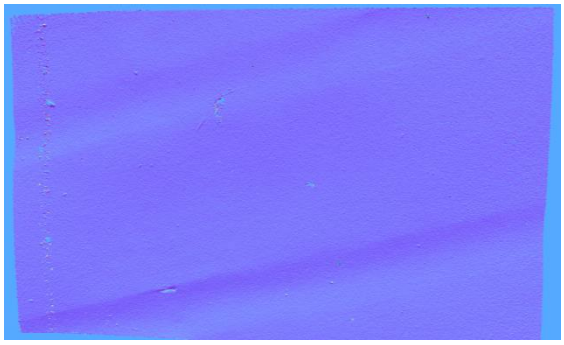



- Plaster casts of different shoes

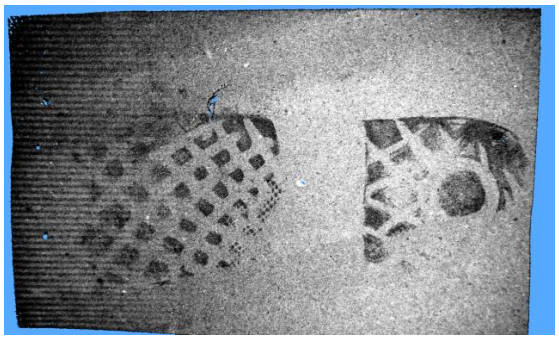


- Latent footwear traces on paperboard



Inclination



Default

EE5	**Landeskriminalamt Sachsen**	**SN**	**DE**	

Brief Description of organisation:

The State Office of Criminal Investigations from the federal state of Saxony has its headquarter in Dresden. They coordinate five police directorates in the region with ca. 4 Mio population. LKA Sachsen's commitment to innovation and research is also shown by its active research and designated research institute: Forensic Science and Technology Institute (*Kriminalwissenschaftliches und -technisches Institut - KTI*).

Website: http://www.polizei.sachsen.de/de/lka.htm

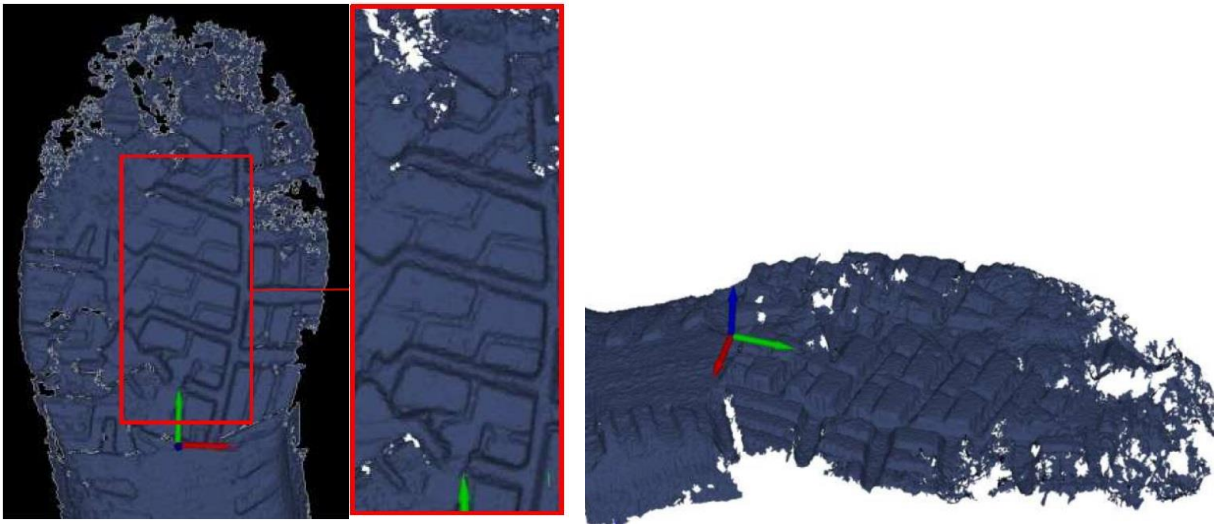
Involvement in 3D-Forensics/FTI (following Table 1):

1) 31/08/2016 | 6 attendees
2) 26-27/10/2016 | 4 attendees
3) 15/11/2016 – 31/03/2017
   2 CSI in CSI unit with experience in 3D scanning, 2 forensic examiners for form traces (trassology), 1 associated tester from university Dresden
4) 11/08/2017 – Feedback on 3D-Scanner and analysis software through report

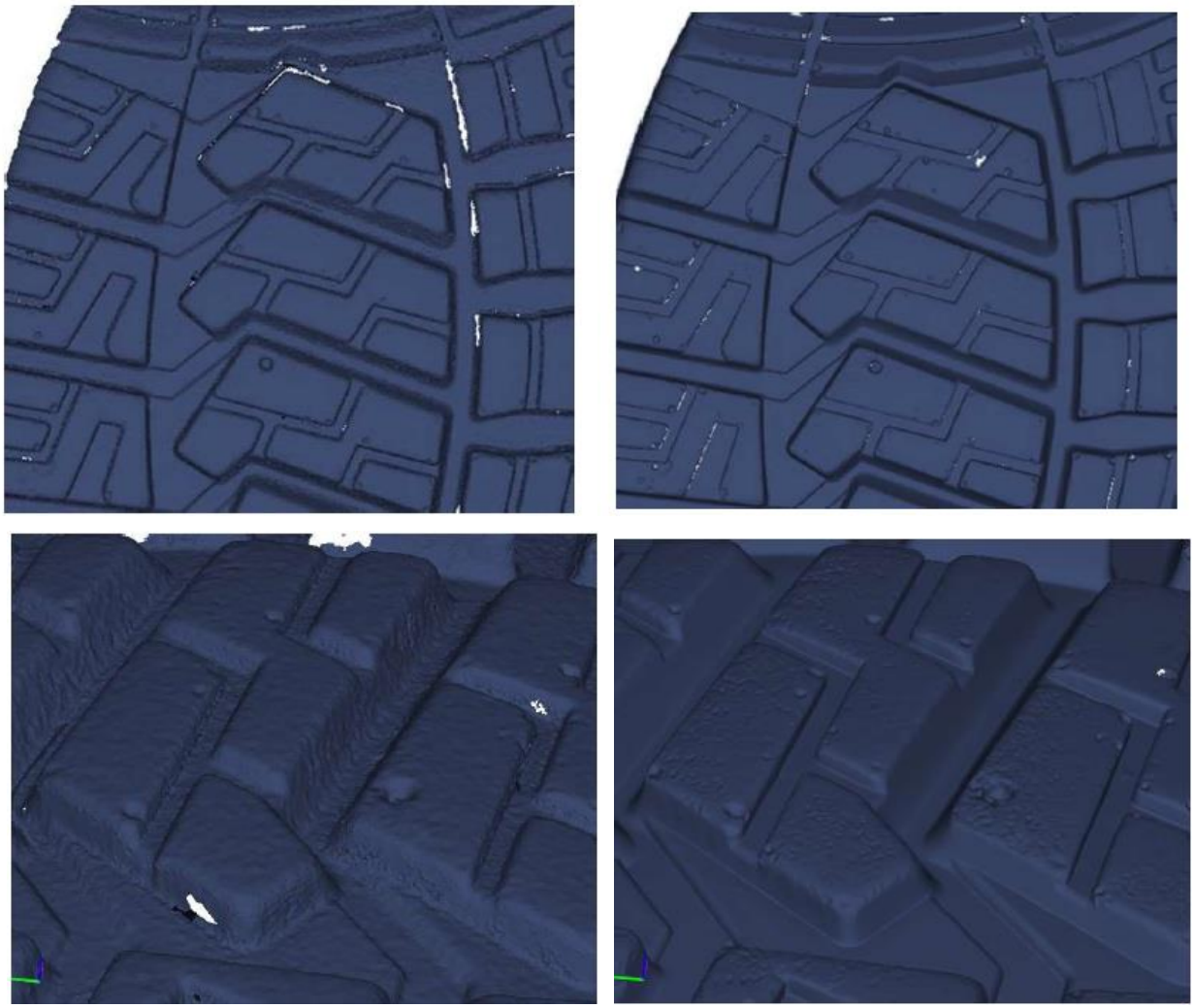
Sample results:

- Photo comparison Canon EOS 100D (28 mm lens) vs. Canon 5D Mark II (50 mm lens)

- Footwear impressions in snow



- 3D-data comparison 3D-Forensics scanner vs. ATOS II



EE6	Estonian Forensic Science Institute (Eesti Kohtuekspertiisi Instituut)	EFSI	EE	

Brief Description of organisation:

The Estonian Forensic Science Institute (EFSI) is a state agency established on 1 January 2008 and administered by the Ministry of Justice with its headquarter in Tallinn. The institute was formed as the result of the merger of two agencies, the Estonian Bureau of Forensic Medicine and the Forensic Service Centre. The principal objectives of the operations of the institute are the provision of forensic science expertise in criminal cases according to competence, the development of the fields of forensic science, the forensic training of police agencies and consultation on matters related to the duties of the institute, and the administration of national databases and registers. EFSI is also one of European Network of Forensic Science Institutes (ENFSI) which is recognized as a pre-eminent voice in forensic science worldwide by ensuring the quality of development and delivery of forensic science throughout Europe.

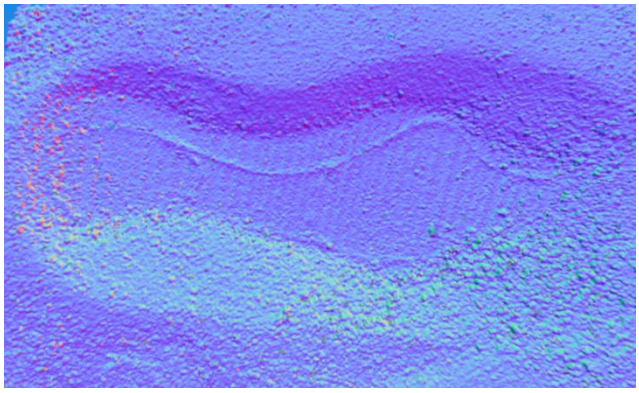
Website: http://www.ekei.ee/

Involvement in 3D-Forensics/FTI (following Table 1):

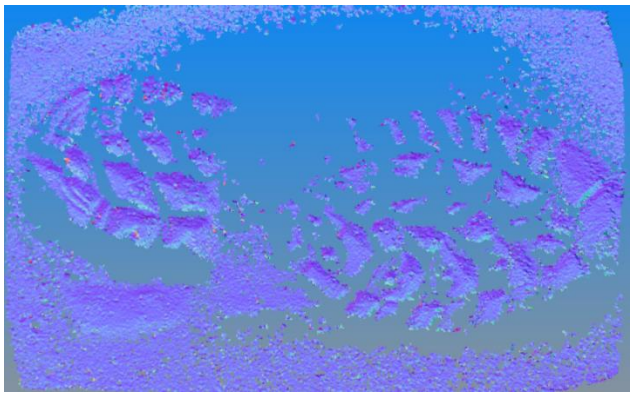
1) 26/04/2017 | 5 attendees
2) 26/04/2017 | 5 attendees
3) 26/04/2017 – 30/08/2017
4) 19/09/2017 – feedback on 3D-Scanner through feedback template

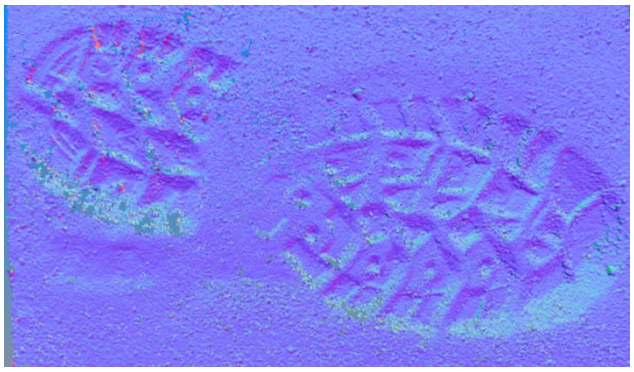
Sample results:

- Footwear impression in sand



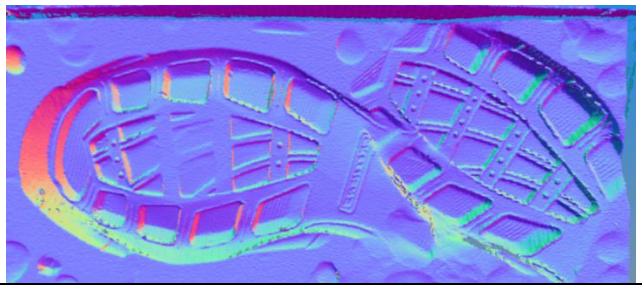
- Scan results with additional external light sources




Coloured mesh

- Overlapping footwear impressions

EE1	Forensische Opsporing Politie Zeeland	PZ	NL	POLITIE

Brief Description of organisation:

The "Forensische Opsporing Politie Zeeland" (Crime Scene Unit of the Zeeland police force) is a special forensic task force that analyses traces in crime scenes. The Crime Scene Unit of the Zeeland police force momentarily uses 3D laser-scanning technique for the 3D digitization of the whole crime scene. It is, however, in planning to use high resolution 3D data of the crime scene, e.g. of footwear impressions, for their future work. PZ is also experienced in all aspects of crime, which can necessitate a 3D-case investigation.

In 3D-Forensics (FP7) project, PZ provided the initial system requirements. They also tested and evaluated the prototype. Its leader was Mr. Andre Hendrix who was directly involved in 3D-Forensics (FP7). Additionally, he has the experience as project manager of the Netherlands Forensic Investigation Team. This last (NFIT) unit is also included in DVI (Disaster Victim Identification). It responds to terrorist attacks and all kinds of disaster with victims involved.

Since the reorganization of the Dutch police that started in 2013, a "National Police" was gradually introduced. This National Police consists of 10 regional brigades and 1 national unit, where before 25 regional brigades existed. The "Forensische Opsporings Dienst Zeeland" merged with the Dutch region "West Brabant" into the "Politie Zeeland West-Brabant". Since the National Police was formed all innovation projects where police or forensic collaboration is required, need to be submitted to the national innovation manager of the ECFO (Expert Center for Forensic Investigation (translated)).

Website: http://www.politie.nl/

Involvement in 3D-Forensics/FTI (following Table 1):

1) PZ was already introduced through their participation in the previous FP7 project 3D-Forensics
2) PZ was already trained through their participation in the previous FP7 project 3D-Forensics
3) PZ is not yet involved with any form of testing yet because the received "Letter of support and intention: 3D-Forensics Fast Track to Innovation project (3D-Forensics/FTI)" by the consortium is no longer valid. Since the National Police is introduced the Politie Zeeland West-Brabant is not allowed to collaborate until approval from the EFCO. There are several contacts active in helping to reinstate the previously granted approval for collaboration. These contacts are within the units "Midden Nederland coordination center" and EFCO. There is still opportunity for involvement of the Politie Zeeland West-Brabant or another Dutch police unit during the 3D-Forensics/FTI project.
4) PZ gave feedback to the prototype system in the end of the previous FP7 project 3D-Forensics. No updated feedback, because they could not perform further testing in 3D-Forensics/FTI.

Sample results:
PZ provided feedback in the end of the previous FP7 project.

2.3 Other end users

In connection with WP1 the consortium had contact with other end users to present the project and system and also in some cases to demonstrate the 3D-Scanner and 3D data analysis software. These end users also provided feedback to the consortium, albeit without extensive testing. These included:

- Carabinieri RIS (IT)
- Landeskriminalamt Berlin (GER)
- Landeskriminalamt Brandenburg (GER)

The project also gave a half-day training workshop with the 3D-Foresics/FTI system at the 102nd International Association for Identification (IAI) International Educational Conference 2017, building on the project presentation delivered at the 101st Conference in 2016. The workshop included over 20 participants from well-respected organisations. Participants at the workshop also had the opportunity to provide feedback. Feedback received confirmed to a considerable extent the core feedback given by members of the EETG. A number of participants also expressed the willingness and interest to test the system. Participants at the workshop included representatives from the following organisations:

- Alaska Scientific Crime Detection Laboratory (USA)
- Federal Bureau of Investigation (FBI) Laboratory (USA)
- Forensic Data Analysis (South Africa)
- Georgia Bureaus of Investigation (USA)
- Hong Kong Police Force (Hong Kong)
- Naval Criminal Investigative Service (USA)
- New York Police Police Department Laboratory (USA)
- Singapore Police Force
- Smyrna Police Department (Georgia, USA)
- National Institute of Standards and Technology (NIST), USA
- Edmonton Police Service (Canada)
- Fort Collins Police Services (USA)
- Baltimore County Police Department (USA)

3 Improvements suggested by end users and conclusions

3.1 General remarks

All involved end users focussed their testing at first on the 3D-Scanner and less on the 3D data analysis software. Therefore the feedback received on the 3D-Scanner may be considered more complete and definite at the moment. However the end users commented on the analysis software as well, mainly in connection with the training workshops.

The feedback and needs and/or preferences for improvement show similarities between the end users but also partly differences. In the following sections the major points are. Internally a more detailed list of feedback and appropriate measures were documented.

3.2 Feedback on overall 3D-Forensics system

The EETG gave indications in which kind of criminal investigations the system could be used. It may be concluded that the performance required from the system is independent of whether it is for used for so-called serious (major) or high volume (minor) crimes.

3.3 Feedback on 3D-Scanner

The members of the EETG tested the 3D-Scanner with respect to the proposed areas to test in the feedback template. In summary, they like the concept of a compact device with integrated PC, touchscreen and battery. The forensic examiners came to the conclusion that the resolution of the 3D data is sufficient for identification analysis of footwear and tyre traces. Most examiners see a possibility to improve the system through a more sophisticated full-format colour camera instead of the current small-format camera. Further, many examiners indicated the external camera should be completely fixed to the 3D sensor to improve the stability of the calibration. However, on the other hand, some suggested using their own photo cameras. The majority would prefer the usage of the scanner with a full-format camera on a tripod, or even a more on a customized quadpod. (A dedicated quadpod has now been developed in the project and first evaluations of data quality with a full-format camera and the quadpod performed.)

The end users tested the 3D-Scanner on different typical materials. The results were fine in most cases. Scans in snow showed data artefacts caused by the (semi-) transparency of the material. It was derived that snow requires some special handling. The scanner will be tested with different scan settings and the usage of special sprays to coat the surface is going to be evaluated.

Several feedbacks were connected with the robustness of the prototype 3D-Scanner. It was already known by the consortium that its robustness, in terms of weather and sunlight, does not yet fulfil the requirements of the end users. Several suggestions for improvement were given by the EETG. In the project robustness of the system is an important condition. Weather robustness will be achieved by using more sophisticated components (robustness against moisture <80%, temperature range -10 … +40°C). The housing will be designed to achieve a protection class of IP44. Further the robustness against sunlight will be improved by using a narrow-band light source to project the fringe patterns.

3.4 Feedback on 3D analysis software

Most members of the EETG focussed their testing on the 3D-Scanner and less on the 3D analysis software. Some had problems to install the software on a suitable PC. It was derived that the software could later be sold in connection with a PC to avoid such problems.

Generally the workflow implemented in the software was confirmed by all users:

1) Data import
2) Preprocessing
3) Class comparison (including entering and/or searching in data base / saved data to compare with known outsoles)
4) Specific characterisation
5) Specific comparison against further traces / suspect(s) shoe(s)

One difficult challenge for the software is that the steps 3) – 5) are done principally by all end users but the specific methods vary between them. The majority would seem to only carry out step 4 if there is a further trace or a suspects shoe to compare under step 5. The software needs to provide more flexibility in steps 3) – 5) to satisfy the needs of users in different organisations.

In connection with the testing of the 3D-scanner it was observed that the calibration of the external colour camera is not stable enough in the prototype. One measure to counter this is that in the advanced prototype the external camera should be completely fixed to the 3D-Scanner. Additionally the software is foreseen to be equipped with a tool to check and recalibrate the camera.

The EETG gave proposals on how to improve the GUI and the toolbar of the software. They further requested additional tools to be used in the comparison process. These requests can be considered to arise from their knowledge of software for comparing 2D images. In the project, we will evaluate how such tools can be realised with 3D data. Additional export format were also proposed. A further improvement would be the possibility to make a 3D print of traces.

3.5 Feedback on system validation

The usage of the scan data as a basis for expert opinion evidence in court requires the proof of the system performance. This means, especially for the 3D-Scanner, the proof of the calibration status. The user needs to have the possibility to check the calibration, and maybe to recalibrate as well.

The advanced prototype will be equipped with a specimen to check the calibration status of the 3D sensor combined with a specimen to check the calibration of the external colour camera. The user will be instructed to check the calibration regularly. A tool to allow the user to recalibrate the colour camera is evaluated. The recalibration of the 3D sensor must be done by the manufacturer.

Calibration is one element connected with validation. The project targets validating the 3D-Forensics system with a user(s) already accredited to:

BS EN ISO/IEC 17025:2005, General requirements for the competence of testing and calibration laboratories; and

BS EN ISO/IEC 17020:2012, Conformity assessment - Requirements for the operation of various types of bodies performing inspection

4 Conclusion

In the first phase the EETG members were introduced to the new technology. Hereby they performed familiarisation as well as first pilot testing using the initial prototype system and provided feedback on the 3D-Forensics prototype system.

Five of the six EETG members were involved deeply in this first phase. But feedback from other organisations was collected as well. The EE1 (Dutch National Police) already provided feedback in the previous FP7 project 3D-Forensics. The EETG members worked each about 3-5 months with a loaned 3D-Scanner. They also received the prototype version of the analysis software. The software testing is still ongoing.

The feedback, which was provided by the EETG and the other organisations, is summarized in chapter 3. A more detailed list, also including measures with regards to how the EETG's suggestions can be fulfilled, was collected internally by the consortium. These measures are now incorporated in technical development tasks in the project.

There are requests from other police organisations to be more deeply involved in the testing of the system. These organisations may be equipped with a loaned 3D-Scanner and analysis software in the next months as well.