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# 3D-Forensics/FTI

## Mobile high-resolution 3D-Scanner and 3D data analysis for Footwear and Tire Track Evidence

102<sup>nd</sup> International Association for Identification (IAI) International Educational Conference, Atlanta, GA, 9 August 2017

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Expert opinion evidence based on new CSI scanning technology – legal duties and quality requirements

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# Overview



- Context (3D-Forensics system)
- Legal duties (England and Wales, UK)
- Quality requirements
- Other relevant guidance
- Court's test for admissibility; *focus sufficiently reliable scientific basis*
- Application for 3D-Forensics system
- Conclusions

***WARNING: Presentation has very broad scope – not possible to cover all detailed aspects conclusively!!! Presentation not prepared to provide legal advice.  
(See also Disclaimer on front cover)***

# Context: Improve forensic processes



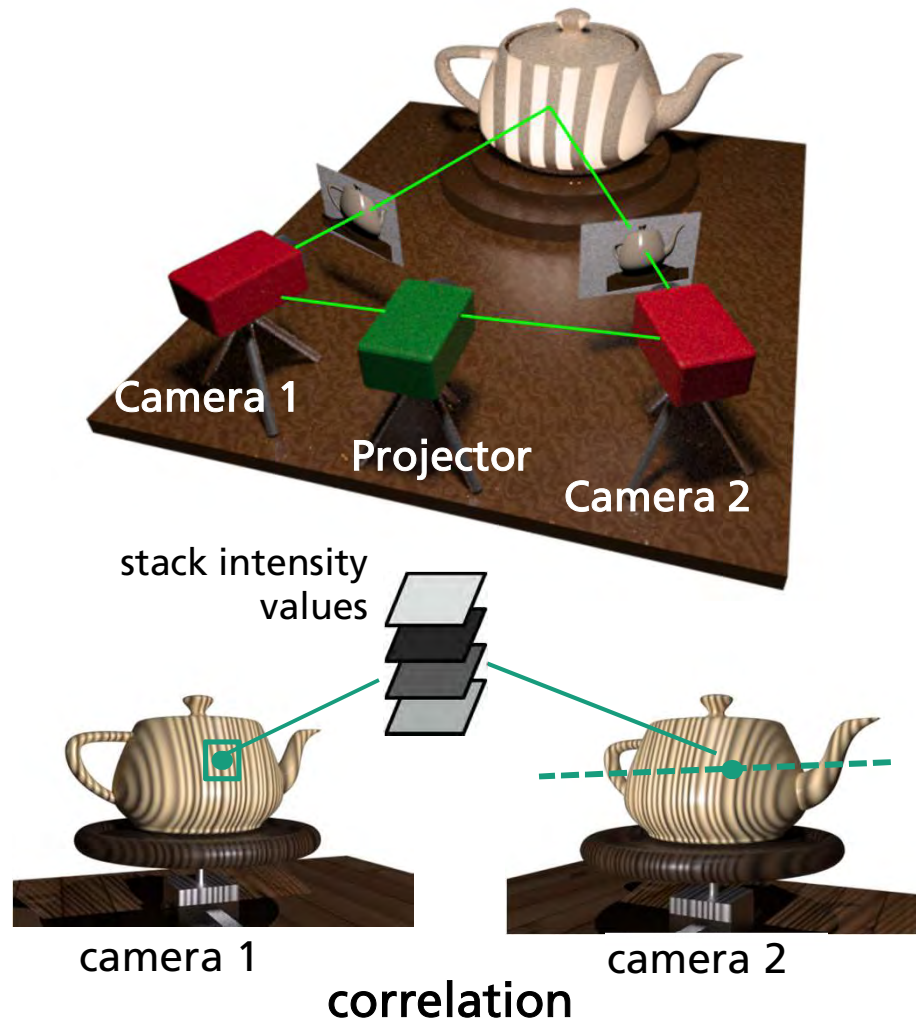
## ■ Traditional recording and analysis procedure



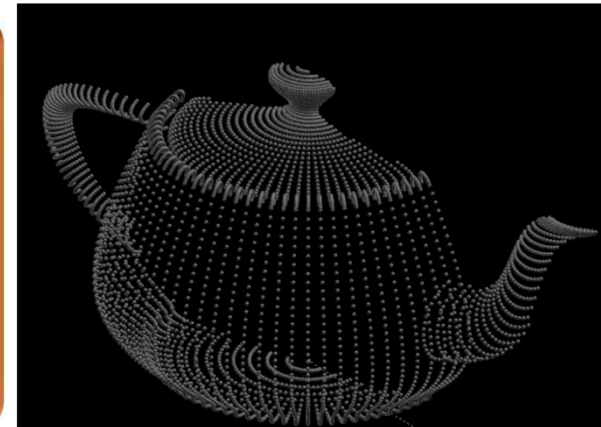
## ■ "3D-Forensics" recording and analysis procedure



# Context: Stereo based pattern projection



3D-Point cloud



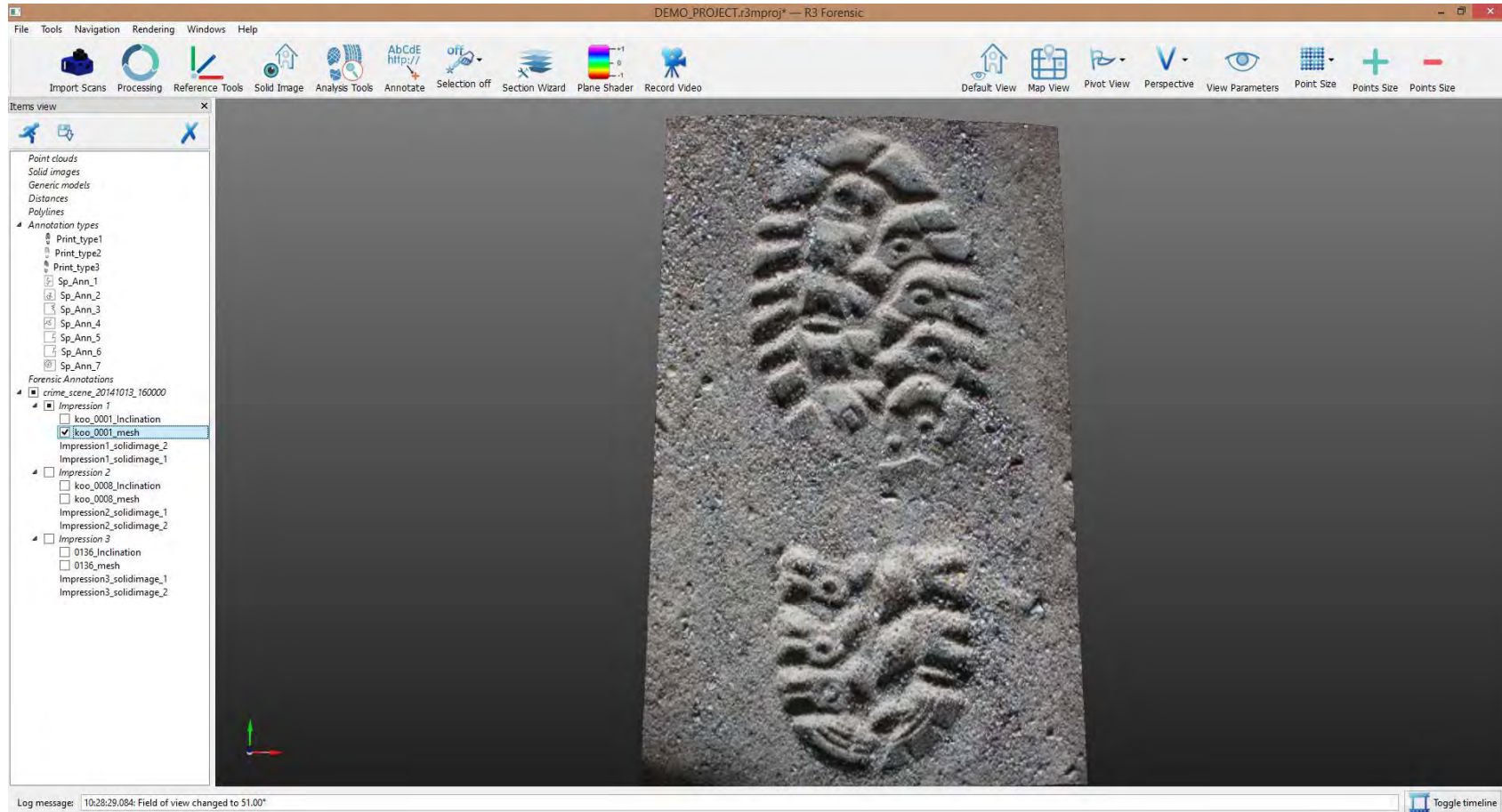
- Projection of a sequence of (fringe) patterns and their correlation
- Scan result are dense 3D point clouds (each camera pixel = 1 point)
- High resolution and accuracy
- Fast, no registration marks

# Context: 3D-Scanner (prototype)

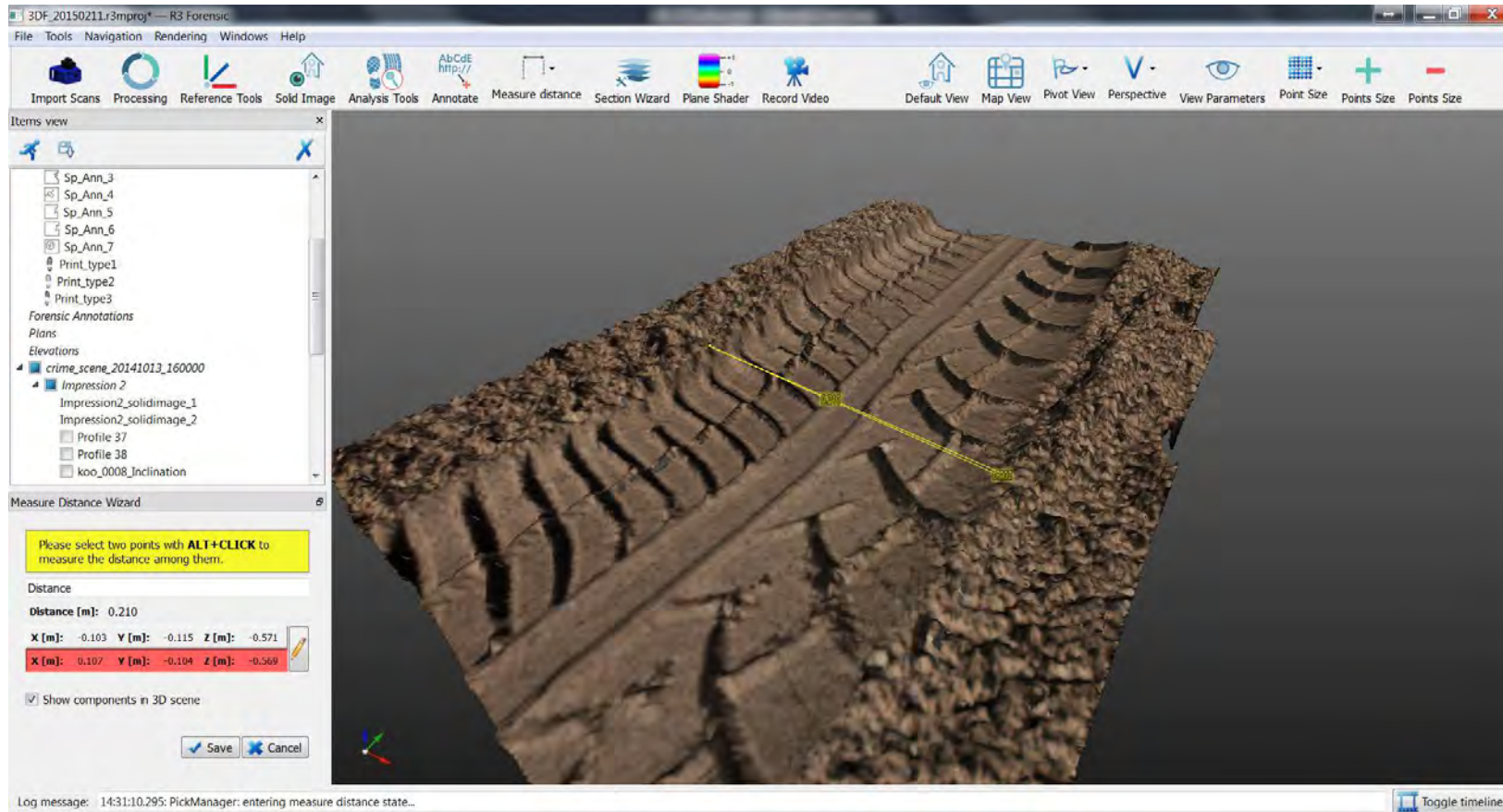


<p>Highly resolved 3D and colour</p>	<p>Simple to use, mobile, handheld</p>	<p>Compact, battery driven</p>
<p>Application outdoors</p>	<p>Equipment for bright sunlight</p>	<p>Easy to transport</p>

# Context: 3D analysis software (prototype e.g.)



# Context: 3D analysis software (prototype e.g.)



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# Context: Expert Opinion Evidence



- Want to ensure expert opinion evidence based on data recorded and analysed with 3D-Forensics system is admissible + maximum weight for the evidence
- Researched/reviewed:
  - Legal duties (England and Wales, UK)
  - Quality requirements
  - Other relevant guidance
  - Court's test for admissibility; focus sufficiently reliable scientific basis
- Input to development process and steps to market





## Expert opinion evidence – legal duties *(England and Wales, U.K.)*

# Overriding duty



- Contribute so cases dealt with justly (Criminal Procedure Rules (CPR) r.1.2(2), r.1.2(1)(a), r.3.3(1)(a), r.3.2(1), r.1.1(1)).
- “Justly” includes:
  - “Acquitting the innocent and convicting the guilty”,
  - “Dealing with the prosecution and the defence fairly” and
  - “Dealing with the case efficiently and expeditiously”
  - dealing with the case in ways which take into account – the gravity of the offence alleged, the complexity of what is in issue and the severity of the consequences

(Full list under CPR r.1.1(2)(a)-(g))

# Specific duties (from CPR)



- Giving opinion which is objective and unbiased (CPR r.19.2(1)(a)(i))
- Within their defined expertise (CPR r.19.2(1)(a)(ii))
- Complying with directions, informing when not (CPR r.19.2(1)(b)(i)-(ii))
- *Other formal requirements – not dealt with here e.g. “signature”*

## Obligations (within duties), include:

- If evidence not admitted as fact write expert report with required content (CPR r.19.3(3)(a), r.19.4)

# Aid to interpretation: expert witness legal duty “maxims”



- Prepared with the greatest of care (*R v B (T)* [2006] 2 Cr App R 22 at [174] , “justly”)
- Uninfluenced by instructing or paying party (CPR r.19.2(2), *R v B(T)* at [176])
- Stay within expertise and state when question or issue falls outside it (in CPR r.19.2(1)(a)(ii) and r.19.2(3)(b), *A local Authority v S* [2009] EWHC 2115 (Fam) at [204])
- State, where relevant, any qualifications to opinion (part of expert’s report CPR r.19.4(g), *National Justice Cia Naviera SA v. Prudential Assurance Co. Ltd (The Ikarian Reefer)* [1993] F.S.R. 563 at [81])
- Communicate change of opinion CPR r.19.2(3)(c)
- Never assume the role of an advocate (“objective and unbiased”, *R v Cleobury* [2012] EWCA Crim 17 at [18].
- Not usurp the function of jury or judge (“objective and unbiased”, *R. v Doheny* [1997] 1 Cr. App. R. 369)
- Disclose all material facts and matters upon which opinion is based and not omit to consider all material facts and matters which could detract from opinion (“justly”, “objective and unbiased”, content of expert’s report, *R v B(T)* at [676D-E])
- Retain and record all case materials (to be able to reveal/disclose them) (*R v B (T)*)
- More definitive evaluative opinion only to be expressed if reliable statistical database or other factors based on experience enable it (“justly”, “objective and unbiased”, “within expertise”, *R v T (footwear mark evidence)* [2010] EWCA 2439).

# Expert's report CPR 19.4



- a) Qualifications, relevant experience and accreditation
- b) Literature or other information relied on
- c) Facts material to the opinions
- d) Facts within own knowledge
- e) Who carried out any examination, measurement, test or experiment
  - i. Qualifications, relevant experience and accreditation
  - ii. Examination, measurement, test or experiment carried out under the expert's supervision?
  - iii. Summary of the findings on which the expert relies
- f) Where range of opinion on the matters dealt with in the report—
  - i. Summarise range of opinion
  - ii. Give reasons for own opinion

# Expert's report CPR 19.4



- g) Any qualifications to an opinion
- h) Include information so court can decide whether expert's opinion is sufficiently reliable\* to be admissible as evidence
- i) Summary conclusions
- j) Statement that expert understands duty court, and has complied and continues to comply with duty\*\*; and
- k) Declaration of truth as a witness statement\*\*.

(CPR r.19.4(a-k))

\* See CPR, Criminal Practice Direction (CPD) 19A.5. factors/flaws for determining reliability

\*\* See CPD 19B.1 for terms to be used / to be similar, includes:

- Understands likely to be subject of criticism by judge if conclusion no reasonable care (*would harm expert's credibility* (see CPR19.3(3)(c))
- Acted in accordance with relevant code of practice or conduct for discipline



## Expert opinion evidence – quality duties

*(focus 3D-Forensics/FTI system)*

# Forensic Science Regulator



## ■ Forensic Science Regulator (FSR)

- “to advise the Government and the criminal justice system on quality standards in the provision of forensic science.”

(Hansard 12 July 2007: The Parliamentary Under-Secretary of State for the Home Department (Meg Hillier MP))

## ■ Terms of reference

- “Establish, and monitor compliance with, quality standards in the provision of forensic science services to the police service and the wider CJS”
- “Ensure the accreditation of those supplying forensic science services to the police, including in-house police services and forensic suppliers to the wider CJS.”

(Terms of Reference for the Forensic Science Advisory Council p.1)

\*CJS = Criminal Justice System



# FSR *Codes of Practice and Conduct*



- FSR *Codes of Practice and Conduct*, Issue 3, (2016)
  - “All practitioners and providers offering forensic science services to the CJS are to be bound by these Codes” (p.14)
  - Code of Conduct: core aspects - overriding duty justice, honesty, integrity, objectivity, impartiality, limits of competence, integrity and continuity of items, methods of demonstrable validity.
  - Code of Practice
    - “aligns with BS EN ISO/IEC 17025:2005 (for testing and calibration laboratories as interpreted by ILAC G19:08/2014)
    - and specifies the requirements for a management system for providers of laboratory-based forensic science services to demonstrate their ability to deliver consistently products and services that meet the requirements of their customers in the Criminal Justice System (CJS)” (p.12)

## FSR *Codes of Practice* – scope (summary)



- Initial forensic science activity at the scene
- Scene examination strategy
- Recovery, preservation, transport and storage of exhibits
- Screening tests for use in the field
- Assessment, selection, examination, sampling, testing and/or analysis of exhibits
- Testing activities using laboratory-based methods
- Recording of actions taken

# FSR *Codes of Practice* - content (*summary*)



- Business continuity
- Independence
- Impartiality and integrity
- Confidentiality
- Training
- Competence
- Test methods and method validation\*
- Measurement traceability
- Opinions and interpretations

\*"The process of providing objective evidence that a method, process or device is fit for the specific purpose intended" The Forensic Science Regulator, *Guidance: Validation* (Issue 1, 2014) p.3)

# FSR *Codes of Practice* – Accreditation



Standards / requirements	Accreditation to ISO/IEC 17025	Accreditation scope to include the Codes	Appendix / Guidance
Footwear impression comparison to evidential standards	April 2012	Oct 2017	
Footwear impression screening	Oct 2017	Oct 2017	
Crime scene examination (BS/EN ISO 17020)	Oct 2020	Oct 2020	UKAS RG201

- Accreditation through United Kingdom Accreditation Service (UKAS®) (p.12)



## Other relevant guidance

*(focus 3D-Forensics/FTI system)*

# Home Office Scientific Development Branch: *Digital Imaging Procedure*



- Details “processes involved in the proper capture and handling of digital images for police applications and to define best working practice.” (p.iv)

## Most relevant to 3D-Forensics/FTI

- Integrity - “the data (image etc.) presented is complete and unaltered since time of acquisition.” (p.7) (e.g. Secure copy, master/working copy, audit trail)
- Authentication - “the data is an accurate presentation of what it purports to be.” (p.77)
- Checking correct operation of equipment (e.g. operator adjustable settings) (p.12)

# FSR, *Forensic Image Comparison and Interpretation Evidence: Guidance for Prosecutors and Investigators*



- Guidance for the expression of a more definitive evaluative opinion enabled through factors based on experience

## Most relevant to 3D-Forensics/FTI

- Structured methodology followed and documented based on tried and tested known material (p.6)
- Evaluative opinions intrinsically based on subjective analysis - independent verification and/or peer-review (p.7)
- Checking image quality to see if it is sufficient for a meaningful and reliable analysis (p.10)



# Admissibility, *(focus reliability of scientific basis)*



# Court's test for admissibility of expert evidence (summary)



- **Relevant** to a matter in issue in the proceedings (*Glaisdale DPP v Kilbourne* [1973] AC 729, *R v Randall* [2004] 1 All ER 467)
- **Needed** to provide the court with information likely to be outside the court's own knowledge and experience (*R v Turner* [1975] QB 834, *Folkes v Chadd* (1782) 3 Doug KB 157)
- **Witness is competent** (*Bonython* [1984] 38 SASR 45 an Australian case but which has been quoted with approval in England and Wales in a number of cases e.g. *R v Stubbs* [2006] EWCA Crim 2312; *Toth v Jarman* [2006] EWCA Civ 1028)

(Based on common law, summarised in CPD19A.1)

If scientific basis for the evidence challenged:

- Subject matter has to be part of a body of knowledge or experience which is sufficiently organised or recognised to be accepted as a reliable body of knowledge or experience

(*R v Dlugosz*, *R v Reed*, CPD19A.4)

# Factors for determining reliability (*summarised*) (1)



- (a) Extent and quality of the data and validity of methods
- (b) Proper explanation of how safe or unsafe an inference is
- (c) if opinion relies on results of use of any method (e.g. test, measurement, survey), whether opinion takes proper account of matters, such as the degree of precision or margin of uncertainty, affecting the accuracy or reliability of those results
- (d) extent any material upon which the expert's opinion is based has been reviewed by others with relevant expertise (for instance, in peer-reviewed publications), and the views of those others on that material
- (e) extent to which expert's opinion is based on material falling outside expert's own field of expertise

(CPD 19A.5)

## Factors for determining reliability (*summarised*) (2)



- (f) completeness of information available to the expert, whether expert took account of all relevant;
- (g) if range of expert opinion on matter in question, where in range expert's own opinion lies and whether expert's preference properly explained
- (h) whether expert's methods followed established practice in field and, if they did not, whether reason for divergence properly explained.

(CPD 19A.5)

## Expert opinion evidence - flaws for determining reliability (*summarised*)



- (a) based on hypothesis not subjected to sufficient scrutiny (including, where appropriate, experimental or other testing), or which failed scrutiny
- (b) based on an unjustifiable assumption
- (c) being based on flawed data
- (d) relying on examination, technique, method or process not properly carried out or applied, or not appropriate for use in particular case
- (e) relying on inference or conclusion not been properly reached.

(CPD19A.6)



## Application for 3D-Forensics/FTI system

# 3D-Forensics/FTI system (*summary*)



Whole set of design requirements to obtain high quality data and analysis fit for purpose e.g. data resolution and accuracy, further...

- Data manipulation prevention

On scanner – password protected user accounts and rights management; transfer – encryption; in office - master / working copy, audit trail, secure police / forensic service provider network)

- Transparency

Each data acquisition and processing step clearly defined and reproducible; color photo and fringe projection (in industrial applications) well known techniques; project structure with meta data; wizards in software; log files; multiple evaluations from raw data possible; exportable in standard formats (to other software)

- Calibration certificate and pieces

- Documenting of testing and scrutiny

- Validation in accredited organisation(s) (*timeframe 2018-2019*)

Engineered product in an accredited process following guidance of FSR and International Laboratory Cooperation (ILAC) organisation.

# Conclusions



- Potential for challenges to the admissibility and weight of expert opinion evidence based on a new scientific technique to be reduced (removed) by demonstrating:
  - Reliability of evidence
  - Credibility of expert
  
- Expert's (and their organisations, where relevant) to:
  - Fulfill legal duties as primarily stated in CPR 19 (incl. CPD)
  - Meet quality requirements stated by FSR
  
- Design and implementation of 3D-Forensics system to enable experts to fulfill legal duties and quality requirements

*Based on research up to 13 July 2017*

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More information?



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