



3D forensic science: An introductory statement from the members of the Forensic Capability Network (FCN) Visual Technologies Research Group (VTRG)

Rachael M. Carew^a, Amber J. Collings^{b,*}

^a School of Life Sciences, Coventry University, Priory Street, Coventry CV1 5FB, UK

^b School of Chemical and Physical Sciences, Keele University, Newcastle ST5 5BG, UK

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ABSTRACT

The Forensic Capability Network (FCN) Visual Technologies Research Group (VTRG) is a collective of academics, consultants, forensic practitioners, and law enforcement with expertise in the developing field of 3D forensic science (3DFS) that was established in 2020. This short communication provides an oversight into the development of the working group and 3DFS as a new subdiscipline of Forensic Science. As a collaborative venture, the VTRG provides a platform to create and disseminate knowledge and experience to improve the efficiency, effectiveness, and strength of partnerships across the criminal justice system. So far, the VTRG has established a user network and has gathered intelligence regarding the current use 3DFS across England and Wales. A clear demand for 3D services has been identified, however, the lack operational guidelines, standardised operating procedures, training or certification, ethical recommendations, quality assurance policies, or formal oversight remains a concern. The VTRG therefore aim to focus future work on promoting effective knowledge transfer and supporting the empirical research that underpins best practice guidance.

1. Introduction

The Forensic Capability Network (FCN) Visual Technologies Research Group (VTRG) is a collective of academics, consultants, forensic practitioners, and law enforcement with expertise in the developing field of 3D forensic science (3DFS) (as defined by Carew et al. [1]). Established in late 2020, VTRG brings together relevant stakeholders to oversee and steer the development and formalisation of 3D forensic science practice. This paper presents the first formal output from the VTRG to recognise the current position of the field of 3D forensic science in England and Wales and set an agenda for its future advancement and international expansion.

2. 3D forensic science as a field

The use of 3D imaging and printing technologies for the analysis, interpretation, and visualisation of forensically relevant materials within England and Wales is increasing in prevalence [2]. There has been a rise in both 3D imaging and printing research representation within the literature [3–6] and use within medico-legal casework in the

UK over the last decade [2,7,8]. Interest in 3D visualisations has particularly been seen in areas that concern human bodies/remains such as forensic pathology [9–11], forensic odontology [8,12], and forensic anthropology [13,14], as well as wider areas of material or scene documentation, such as crash investigations [15], or evidence recovery [16]. The use of 3D printing in forensic science has been more recently highlighted through both casework and research endeavours [2,7,8,17,18]. With the future development of technology, this is likely to only increase. In recognition of this increase, 3D forensic science (3DFS) has recently been coined as a new field within forensic science [1].

3DFS as a field can be defined as the application of 3D imaging and printing techniques for forensic reconstruction purposes [1]. Within 3DFS, those techniques can be utilised across the criminal justice system, from documenting and digitally preserving evidence, to creating 3D visual representations of evidence, through to the presentation of evidence in a court of law. The goal of 3DFS is to complement and support forensic investigations and expert witness testimony with 3D services, whether entered as visual aids or evidential exhibits, ultimately facilitating improved comprehension for lay members of the court including the judge, barristers, and jury members [1,19].

* Corresponding author.

E-mail address: a.j.collings@keele.ac.uk (A.J. Collings).

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3. Initial development of the research group

The VTRG developed from a growing need to recognise and formalise 3D printing in UK forensic science. In their 2020 technical report, Carew and Errickson [18] suggested a national working group be formed to enforce a traceable, accurate, legal, and standardised approach to forensic 3D printing by guiding, developing, and validating best practice protocols. In response to this suggestion and their call for a more aligned and collaborative community, the VTRG was established in late 2020, following discussions with the Forensic Capability Network (FCN) in the UK. While originally founded on the principle of knowledge exchange and practitioner-based research in 3D printing (approaching two of the six key research questions and agenda points posed by Carew and Errickson [18]), it was agreed by members in the initial meetings that 3D data capture could not be ignored. The research group consequently includes all aspects of the 3D workflow in 3DFS in its remit.

At present, the group has ~70 members and approximately 44 participants attending at the quarterly meetings. Approximately half of the attendees are employed by law enforcement agencies (LEA), 8 belong to the private sector (including forensic pathologists and anthropologists), and 16 are from academia. Despite being set up in the UK, as a national working group, the group has regular attendees from Scotland, India, Australia, The Netherlands, and Sweden, further enhancing the collaborative spirit of the group and enhancing knowledge exchange opportunities. The working group sits within the ‘Research and Development’ stream of the FCN and is overseen by an FCN Scientific Officer.

4. VTRG agenda and current progress

The future of 3DFS relies on collaborative work between academia and law enforcement practitioners across the criminal justice system. The VTRG provides the platform to facilitate such collaborative partnerships and aims to “*improve the effectiveness and efficiency of policing, forensic science, technology and associated methods and techniques through collaborative information sharing, broadening access to knowledge and partnerships across the criminal justice system*” [20].

Since its formation, the VTRG has established a user network acting to increase communication across the community and enabled a more coordinated effort toward best practice. Furthermore, through meeting discussions and feedback sessions, it has gathered intelligence on current 3DFS practices across the UK and put in place a platform for the exchange of research findings and casework feedback. The Current VTRG objectives and contact details for the group chair are available on the FCN’s website [20]. We would encourage anyone interested in joining the working group to contact the group chair with an expression of interest.

It should be noted that while currently operating as a national working group to formalise, develop, and drive 3DFS best practice within the bounds of the English and Welsh legal system, the range of perspectives and enhanced knowledge exchange opportunities provided in our meetings by our international collaborators are fundamental in driving best practice, not only nationally but internationally too. As the transition towards international standardisation and ISO accreditation of policing and forensic science practices continues, we hope to expand the working group remit internationally.

5. Current operational landscape

Currently, there is no legal requirement for 3DFS services or deliverables to be accredited or validated for use in court, however, given the increasing scope and powers of the UK Forensic Science Regulator [21], there may well be in the future. Indeed, 3D imaging and printing may potentially be considered as falling under the umbrella of digital forensic evidence from an accreditation perspective. Similarly, with no operational guidelines, standardised operating procedures, training or certification, ethical recommendations, quality assurance policies, or

formal oversight in place, there are concerns regarding effective and efficient best practices. Further, without formal oversight, there is a greater potential for 3DFS to be used in a misleading manner or possibly resulting in unsafe rulings [1]. With limited operational pathways, services are being rendered ad hoc and when they cannot be completed in-house must rely on word-of-mouth to identify providers. The general understanding of 3DFS as a service and its value across the entire law enforcement community is also minimal. While the VTRG group have identified that there is a clear demand for 3DFS services in the UK, a limited understanding of service value can lead to uneven distribution, utilisation, and unmet expectations in terms of what can be produced in given timeframes [2].

6. Future work

The authors recognise a need to progress from the current landscape towards one where we can rely on formalised procedures and reliable outcomes. The VTRG have made progress towards connecting the 3DFS community and believe that development towards a position where practice can be validated is valuable even at this stage (when it is not yet a legal requirement). Validation helps to ensure demonstrably reliable, ethical, accurate, and robust practices are used in courts of law. While there has been some work conducted in this area to date (e.g. [22,23]) further method and output validation will set the groundwork for any future accreditation requirements should they arise.

Collectively, VTRG, plan future work to promote effective knowledge transfer and support the empirical research that underpins best practice guidance. The following key research areas for the community have been suggested:

- Identifying the ethical considerations of using 3DFS within investigations and the courtroom
- Establishing standardised best practice and guidance protocols
- Exploring the operational value of 3DFS in investigations (including cases that involve violence against women and girls – government priority)
- Investigating the impact of 3DFS on the psychological well-being of practitioners and jury following visual exposure to 3D evidence
- Quantifying and validating the accuracy of 3D reproduction (quality assurance/ level of tolerance)
- Exploring the operational issues associated with 3DFS in the persistence, transfer, and recovery of trace materials
- Exploring the operational applications of 3DFS beyond visualisation and toward analyses (blood pattern analysis, ballistic reconstruction, physical fit etc.)
- Exploring the use of VR/AR technology in 3DFS

Going forward, once the field is in a more established position, work towards a 3DFS primer for the courts of law will be prioritised to further meet our objectives. It is the current position of the VTRG that the 3DFS field in England and Wales needs further consideration and guidance and that this group is well placed to facilitate this transition. This would mark the first step toward a more standardised approach to 3DFS globally.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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