



## Summary of Experience

Mr. Terpstra has focused his professional practice and research in computer visualization. Since 2005, Toby has acted as the Senior Animator at Kineticorp, now a part of J.S. Held. He specializes in 3D analysis, site reconstruction, photogrammetry, video analysis, visibility, interactive media, and 3D visualization. He is currently the lead instructor of an ACTAR accredited course offered by the Society of Automotive Engineers titled "Photogrammetry and Analysis of Digital Media". Mr. Terpstra has also taught and conducted research on topics such as onsite photogrammetry, photoscanning, video analysis, videogrammetry, lens distortion, LiDAR, body worn cameras, trajectory rod documentation, acoustics, and 3D visualization.

## Key Expertise

- Video Analysis
- Photogrammetry
- 3D Analysis
- Site Reconstruction
- Computer Visualization
- Visibility
- Interactive Media
- Acoustics

## Education

AAS, Visual Communication, Westwood College of Technology, 2001

Multimedia Program, University of Colorado at Denver, 2000-2001

Architecture & Graphic Design Programs, Arapahoe Community College, 1998-2000

## Project Geographical Experience

U.S., Mexico, Italy, Hong Kong

## Expert/Testifying Experience

Mr. Terpstra has testified in state and federal courts on civil and criminal matters, and has been retained by plaintiff, prosecution, and defense counsel. Mr. Terpstra has also presented written and oral expert witness testimony in alternate dispute resolution procedures including mediations and arbitrations.

## Professional Affiliations and Certifications

SAE member 2011 (Society of Automotive Engineers)

ASPRS member 2014 (American Society for Photogrammetry & Remote Sensing)

IAFSM member 2015 (International Association for Forensic & Security Metrology)

ACSR member 2020 (Association for Crime Scene Reconstruction)

AFI member 2020 (Association of Force Investigators)

ASA member 2019 (Acoustical Society of America)

AFTE technical advisor 2020 (The Association of Firearm and Tool Mark Examiners)

OSAC (Organization of Scientific Area Committees for Forensic Science), Crime Scene Investigation & Reconstruction Subcommittee, Forensic Metrology Task Group 2022

Forensic Video Technician (LEVA), Kansas City Regional Police Academy, May 2019

Remote Pilot, Small Unmanned Aircraft System Rating, Federal Aviation Administration (FAA), February 2018

Human Participant-based Research, National Institutes of Health (NIH) Office of Extramural Research, April 2016

## Role at J.S. Held

As a Principal Forensic Animator at J.S. Held, Mr. Terpstra assists in the training and teaching of visualization staff, managing staff and company projects, developing, and directing the technology related to accident reconstruction, forensics, photogrammetry, computer modeling, and visualization.

## Contact

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## Work Experience

J.S. Held, LLC  
Principal Forensic Animator  
2021 – Present

Kineticorp – Department of Visualization  
Principal Forensic Animator  
2005 – 2021

Knott Lab – Department of Visualization  
Forensic Animator  
2003 – 2005

## Select Project Experience

### Forensic Analysis & Visualization

- Development of the nation’s first ACTAR accredited course on photogrammetry in accident reconstruction.
- Creation and development of the Digital Reverse Camera Projection (DRCP) onsite photogrammetry application available on the Google Play Store.
- Investigation and digital mapping of hundreds of vehicles, accident scenes, and shooting incident sites.
- 3D analysis of shooting incidents, vehicle accidents, industrial accidents, premises liability, sports related injuries.
- Production of 3D animations, graphics and interactive media for depositions, mediation, and courtroom exhibits.
- 3D trajectory analysis for projectiles in shooting and use of force cases.
- Full scale vehicle testing, documentation, and analysis.
- Vehicular accident reconstruction animations for court cases nationwide, as well as for Denver’s Channel 4.
- Acoustics as related to accurate reproduction of sound for use in the courtroom.

### Additional 3D Experience:

- (AASHTO) American Association of State Highway Transportation: 3D models of weather patterns and weather-related concepts for computer-based training.
- (USDOT) United States Department of Transportation, (FHWA) Federal Highway Administration: Environmental impact 3D pre-visualization and animation.
- (USAF) United States Air Force, (CEMM) Center of Excellence for Medical Multimedia: Medical 3D animations. [www.cemm.org](http://www.cemm.org)

## Awards

“Outstanding Oral Presentation Award” Society of Automotive Engineers (SAE) “The Application of Augmented Reality to Reverse Camera Projection” 2019.

## Technical Training, Classes and Conferences

1. “Photography for Accident Reconstruction, Product Liability and Testing” Society of Automotive Engineers Course C1729, 3-day course, Oxnard, CA. July 2022.
2. “Bridging the Technology Gap” Forensic Metrology and Crime Scene Reconstruction (ACSR/ IAFSM), Joint Conference Westminster, CO. February 2022.
3. Mass Casualty Exercise Organizer for the Forensic Metrology and Crime Scene Reconstruction (ACSR/ IAFSM), Joint Conference 1<sup>st</sup>Bank Center, Westminster, CO. February 2022.
4. Active Shooter Training, Broomfield Police Department, 1<sup>st</sup> Bank Center, Westminster, CO. February 2022.

5. "Body -Worn Cameras" Force Science Institute, New York State Police Academy, Albany, NY. June 2021 (2-day course).
6. Annual conference training and workshops. Association for Crime Scene Reconstruction, Tulsa, OK. March 2021.
7. Annual conference training and seminars. Association for Crime Scene Reconstruction, Reno, NV. March 2020.
8. "Digital Multimedia Evidence Processing" Law Enforcement & Emergency Services Video Association (LEVA) International Inc., at Kansas City Regional Police Academy. May 2019 (5-day course).
9. "Long Exposure Photography at a Crime Scene" Association for Crime Scene Reconstruction, Nashville, TN. February 2019.
10. "Using SketchUp in Crime Scene Reconstruction" Association for Crime Scene Reconstruction, Nashville, TN. February 2019.
11. Annual conference training and seminars. Association for Crime Scene Reconstruction, Nashville, TN. February 2019.
12. "Forensic Video Analysis & The Law" Law Enforcement & Emergency Services Video Association (LEVA) International Inc., at North Carolina State Bureau of Investigation. June 2018 (5-day course).
13. "Advanced Photogrammetry for Collision Reconstruction" PhotoModeler class, Denver, CO. October 2017 (3-day course).
14. "Advanced Matchmoving Strategies in PFTrack" The Pixel Farm, September 12, 2017.
15. "High Accuracy Mapping with DJI Drones" The Pixel Farm, August 8, 2017.
16. "Human Factor in Driver Vision and Lighting" and "Occupant Protection: Accident Reconstruction" seminars. SAE World Congress, Detroit, MI. April 2017.
17. Annual conference training and seminars. Association for Crime Scene Reconstruction, Black Hawk, CO. February 2017.
18. UAS Flight Safety Program. 1UP Aerial Drone Services Inc, Greenwood Village, CO. September 2016.
19. Live vehicle crash tests, presentations, and seminars. World Reconstruction Exposition, Orlando, FL. May 2016.
20. "Human Factor in Driver Vision and Lighting" and "Occupant Protection: Accident Reconstruction" seminars. SAE World Congress, Detroit, MI. April 2016.
21. "World DEM" American Society of Photogrammetry and Remote Sensing Annual Conference, Fort Worth, TX. April 2016.
22. "Shooting Incident Reconstruction" Bevel Gardner and Associates, Denver, CO July 2015 (5 days).
23. "Admissibility of 3D Evidence" SPAR International, Colorado Springs, CO. April 2013.
24. "Occupant Protection: Accident Reconstruction" seminars. SAE World Congress, Detroit, MI. April 2011.
25. "Noise: Active Noise, Product Noise, and Community Noise." Acoustical Society of America 156th Annual Conference, Miami, FL. 2008.
26. "Tire Mechanics & Modeling." Colorado State University, Denver, CO. March 2008.

### **Invited Lectures and Courses Taught**

1. "Photogrammetry and Analysis of Digital Media" Society of Automotive Engineers Course C1712, 3-day course, Troy, MI. September 2022.
2. "Aerial Photoscanning with Ground Control Points from USGS LiDAR" SAE Technical Paper Presentation, SAE World Congress, 2022.
3. "Basic Laser Scanner Certification Course" International Association of Forensic and Security Metrology, Westminster, CO. 2022.
4. "Video Synchronization Reliability for Body-Worn Cameras, Dash Cameras, Surveillance, and Cell Phone Cameras" Association for Crime Scene Reconstruction and International Association of Forensic and Security Metrology joint conference, Westminster, CO. 2022.
5. "Photogrammetry and Analysis of Digital Media" Society of Automotive Engineers Course C1712, 3-day course, Troy, MI. September 2021.
6. "Using Motion Capture Technology with Witness-based Positions in Use of Force Analysis" Association for Crime Scene Reconstruction, 31st annual conference, Tulsa, OK. 2021.
7. "Analysis of Body Worn Camera Photogrammetry using Depth Mapping" American Academy of Forensic Sciences, 73rd annual scientific meeting. 2021.
8. "Determining Range of Certainty in Photogrammetry and Videogrammetry" American Academy of Forensic Sciences, 73rd annual scientific meeting. 2021.
9. "Accuracies in Single Image Camera Matching Photogrammetry" SAE Technical Paper Presentation, SAE World Congress, 2021.

10. "Utilizing LiDAR and Photogrammetry-based Point Clouds for Shooting Incident Analysis" Association for Crime Scene Reconstruction, 30th annual conference, Reno, NV. 2020.
11. "Examination of Trajectory Rod Mapping Methods" Association for Crime Scene Reconstruction, 30th annual conference, Reno, NV. 2020.
12. "Photogrammetry and Analysis of Digital Media" Society of Automotive Engineers Course C1712, 3-day course, Troy, MI. September 2019.
13. "Photogrammetry and Analysis of Digital Media" Society of Automotive Engineers Course C1712, 3-day course, Troy, MI. June 2019.
14. "Empirical Evaluation of In-Field, Binaural Record and Playback Reproduction" Acoustical Society of America 177th Meeting, Louisville KY. 2019.
15. "Reconstruction of 3D Accident Sites Using USGS LiDAR, Aerial Images, and Photogrammetry" SAE Technical Paper Presentation, SAE World Congress, Detroit, MI. 2019.
16. "The Application of Augmented Reality to Reverse Camera Projection" SAE Technical Paper Presentation, SAE World Congress, Detroit, MI. 2019.
17. "Alleged Excessive Force Recreation Using LiDAR and Photogrammetry" Association for Crime Scene Reconstruction, 29th annual conference, Nashville, TN. 2019.
18. "Photogrammetry and Analysis of Digital Media" Society of Automotive Engineers Course C1712, 3-day course, Troy, MI. June 2018.
19. "Using Multiple Photographs and USGS LiDAR to Improve Photogrammetric Accuracy" SAE Technical Paper Presentation, SAE World Congress, Detroit, MI. 2018.
20. "Photogrammetry and Analysis of Digital Media" Society of Automotive Engineers Course C1712, 3-day course, Troy, MI. December 2017.
21. "An Evaluation of Two Methodologies for Lens Distortion Removal when EXIF Data is Unavailable." SAE Technical Paper Presentation, SAE World Congress, Detroit, MI. 2017.
22. "Digital Imaging Devices for Accident Reconstruction" SAE Technical Session: Knowledge Bar, SAE World Congress, Detroit, MI. 2017.
23. "Using Photogrammetry and 3D Analysis to Determine Visibility Through a Weapon Sight" Association for Crime Scene Reconstruction, Black Hawk, CO. 2017.
24. "Using Accident Reconstruction Methods to Help Solve Shooting Incidents" Association for Crime Scene Reconstruction, 27th annual conference, Black Hawk, CO. 2017.
25. "A Survey of Multi-View Photogrammetry Software for Documenting Vehicle Crush." SAE Technical Paper Presentation, SAE World Congress, Detroit, MI. 2016.
26. "3D Analysis and Visualization" – Ohio Organized Crime Investigations Commission, Grove City, OH. 2015.
27. "Forensic Photogrammetry – Extracting Critical Evidence from Crash Photos." SAE Presentation Panel, SAE World Congress. Detroit, MI. 2011.
28. "Photogrammetric Measurement Error Associated with Lens Distortion." SAE Technical Paper Presentation, SAE World Congress. Detroit, MI. 2011.
29. "Topics in Noise – Active Noise, Product Noise, and Community Noise." Acoustical Society of America 156th Annual Conference, Miami, FL. 2008.
30. "Topics in Architectural Acoustics: Acoustics in Rooms, Ducts, and Forensics." Acoustical Society of America 153rd Annual Conference, Salt Lake City, UT. 2007.
31. Advanced Animation course, Art Institute of Colorado, Denver, CO. 2006.

## Selected Publications

### Technical, Peer Reviewed Publications

1. **Terpstra, T.**, Mckelvey, N., King, E., Hashemian, A., King, C., "Aerial Photoscanning with Ground Control Points from USGS LiDAR." SAE, Paper 2022-01-0833. Detroit, MI. (2022). – *Recognized as one of the best publications from SAE World*

*Congress 2022 and published in the SAE International Journal of Advances and Current Practices in Mobility.*

2. Mckelvey, N., King, C., **Terpstra, T.**, Hashemian, A., Mitchell, S., "Accuracy of Aerial Photoscanning with Real-Time Kinematic Technology." SAE, Paper 2022-01-0830. Detroit, MI. (2022).
3. **Terpstra, T.**, Neale, W.T.C., Owens, T., King, E., Bier S., Voitel, T., "An Analysis of Body-Worn Camera Photogrammetry Using Depth Mapping." *Proceedings of the American Academy of Forensic Sciences, 73<sup>rd</sup> Annual Scientific Meeting, Held Virtually. 2021. C21.*
4. **Terpstra, T.**, Neale, W.T.C., King, E., Hashemian, A., Hessel, D., "Determining Range of Certainty in Photogrammetry and Videogrammetry." *Proceedings of the American Academy of Forensic Sciences, 73<sup>rd</sup> Annual Scientific Meeting, Held Virtually. 2021. C21.*
5. **Terpstra, T.**, Owens, T., Hashemian, A., Voitel, T. "Depth Mapping Accuracy Evaluation of the Microsoft Kinect v2 Motion Capture Sensor" *Journal of the Association for Crime Scene Reconstruction (2021) 25:1-10.*
6. **Terpstra, T.**, Hashemian, A., Gillihan, R., King, E. Miller, S., Neale W.T.C., "Accuracies in Single Image Camera Matching Photogrammetry." SAE, Paper 2021-01-0888. Detroit, MI. (2021).
7. Neale, W.T.C., **Terpstra, T.**, McKelvey N., Owens, T., "Visualization of Driver and Pedestrian Visibility in Virtual Reality Environments." SAE, Paper 2021-01-0856. Detroit, MI. (2021).
8. **Terpstra, T.**, Hashemian, A., Voitel, T., Priest, J. "A Comparison of Metrology Used in Documenting Shooting Incident Trajectories" *Journal of the Association for Crime Scene Reconstruction (2020) 24:23-42.*
9. Neale, W.T.C., **Terpstra, T.**, Beauchamp G., "Empirical Evaluation of In-Feld, Binaural Record and Playback Reproduction." *The Journal of the Acoustical Society of America 145, 1890. (2019).*
10. **Terpstra, T.**, Dickinson, J., Hashemian, A., Fenton, S., "Reconstruction of 3D Accident Sites Using USGS LiDAR, Aerial Images, and Photogrammetry." SAE, Paper 2019-01-0423. Detroit, MI. (2019).
11. **Terpstra, T.**, Beier, S., Neale T.C, W., "The Application of Augmented Reality to Reverse Camera Projection." SAE, Paper 2019-01-0424. Detroit, MI. (2019).
12. **Terpstra, T.**, Neale, W.T.C., Hashemian, A., "Photogrammetry and Analysis of Digital Media" Version: 002, Published through SAE Technical Course Material, Troy Michigan. (2018).
13. **Terpstra, T.**, Dickinson, J., Hashemian, A., "Using Multiple Photographs and USGS LiDAR to Improve Photogrammetric Accuracy." SAE, Paper 2018-01-0516. Detroit, MI. (2018). – *Recognized as one of the best SAE World Congress 2018 publications and published in SAE International Journal of Transportation Safety Volume 6, Issue 3, 2018.*
14. **Terpstra, T.**, Neale, W., Hashemian, A., "Photogrammetry and Analysis of Digital Media" Published through SAE Technical Course Material, Troy Michigan. (2017).
15. **Terpstra, T.**, Miller, S., Hashemian, A., "An Evaluation of Two Methodologies for Lens Distortion Removal when EXIF Data is Unavailable." SAE, Paper 2017-01-1422. Detroit, MI. (2017).
16. Muttart, J., Dinakar S., Suway J., Kuzel M., Maloney T., Biever W., **Terpstra T.**, Voitel T., Cavanaugh D., Harms T., "Comparing A Timed Exposure Methodology to the Nighttime Recognition Responses from SHRP-2 Naturalistic Drivers." SAE, Paper 2017-01-1366. Detroit, MI. (2017).
17. **Terpstra, T.**, Voitel, T., Hashemian, A., "A Survey of Multi-View Photogrammetry Software for Documenting Vehicle Crush." SAE, Paper 2016-01-1475. Detroit, MI. (2016).
18. Neale, W.T.C., Hessel, D., **Terpstra, T.**, "Photogrammetric Measurement Error Associated with Lens Distortion." SAE, Paper 2011-01-28611B-0043. Detroit, MI. (2011).
19. Neale, W.T.C., **Terpstra, T.**, Bortles W. M., "Evaluation of Discrete Vehicle Accident Sounds for use in Accident Reconstruction." *Proceedings of Meetings on Acoustics Vol.5 (2008).*
20. Neale, W.T.C., **Terpstra, T.**, Bortles W. M., "Analysis of Commonly Witnessed Vehicle Accident Sounds *in situ.*" *The Journal of the Acoustical Society of America 124:4 (Oct. 2008): 5aNS5.*

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21. Neale, W.T.C., **Terpstra, T.**, “Methodology for Physics-Based Sound Composition in Forensic Visualization.” *Proceedings of Meetings on Acoustics* Vol.1 (2007).
  22. Neale, W.T.C., **Terpstra, T.**, “Methodology for Reconstruction of Vehicle Accident Acoustics for use in Forensic Visualization.” *The Journal of the Acoustical Society of America* 121:5 (May 2007): 3pAA8.

#### **Other Publications & Articles**

23. **Terpstra, T.**, et al. *Art of The Point Cloud* p.70-71, 84-85, ISBN 978-1-9997189-1-6, Wild Harbor Books Glasgow, 2018.
24. Voitel, T., **Terpstra, T.**, “Benefits of 3D Laser Scanning in Vehicle Accident Reconstruction”, FARO – Technology White Paper, May 2012.