Photogrammetry for Height Analysis

Course Synopsis and Hour-by-Hour Schedule

Five-day delivery | Version 1, prepared 1 September 2026

1. Course synopsis

Photogrammetry for Height Analysis is a five-day course in the recovery of subject height from video evidence, and in the expression of that result with a defensible statement of uncertainty.

The course is structured around the sequence an analyst follows in casework. It begins with the recording, establishing that the file is what the camera produced and identifying what compression and lens optics have done to the image from which the measurement will be taken. It proceeds to the scene, where the supporting geometry is established, verified and documented. Both are then brought into software, where height is recovered by triangulation from two viewpoints or by reverse projection from one. The course concludes with the statistical treatment of repeated measurements, the biomechanical basis for frame selection, and the presentation of the result in a report and under cross-examination.

Approximately one third of instructional time is delivered as practical work at a participant workstation. Participants process point cloud data in CloudCompare and complete a series of graduated exercises in PhotoModeler, working from a scanned scene and from a camera calibration set they capture themselves. Several exercises are configured to produce poor solutions, so that participants encounter the common failure modes under supervision rather than in casework.

Assessment is conducted on the final day and comprises a written examination and a practical examination.

2. Course structure

Day	Focus	Runs	Instruction
1	Video integrity, compression, camera fundamentals and projection geometry	09:00 to 17:00	6.75 h
2	Single-view measurement and scene examination	09:00 to 16:45	6.25 h
3	Point cloud data, photogrammetric principles and initial solutions	09:00 to 17:15	6.75 h
4	Reverse projection, statistical treatment and legal context	09:00 to 18:00	6.75 h
5	Biomechanics, courtroom presentation and examination	09:00 to 15:30	5.5 h
	Total instructional hours		**32 h**

Total instructional time is 32 hours, of which 11 hours are delivered as practical work at a participant workstation. Meal periods and rest breaks account for a further 6.75 hours and are not credited.

3. Learning outcomes by module

The course comprises seven modules. The module numbers shown in the schedule at Section 4 correspond to the headings below.

Module 1. Video integrity, camera fundamentals and projection geometry

Module 1 establishes the properties of the recording and of the camera that produced it. It covers the integrity of the evidential file, the effect of compression and lens distortion on the image, and the projective geometry that permits measurement from a single camera view.

On completion of this module, participants will be able to:

- Distinguish the integrity of an evidential video file from its suitability for measurement, and assess each separately.
- Establish and document the provenance of a video file, and maintain an unaltered original throughout the examination.
- Differentiate a container format from the codec it carries, and identify footage that has been transcoded.
- Explain the distinction between I, P and B frames and its significance for the selection of a measurement frame.
- Identify compression artifacts, interlacing, rolling shutter and pixel aspect ratio error, and attribute each to its originating mechanism.
- Relate focal length, sensor size, field of view and pixel pitch, and interpret camera specifications correctly.
- Account for lens distortion, including its distribution across the frame, and select an appropriate correction method.
- Construct vanishing points, and apply the horizon and ground plane to a single-view measurement.
- State the conditions under which single-view measurement is defensible, and those under which it is not.
- Perform a single-view height analysis in Amped FIVE, and identify the uncertainty contributions the software does not report.
- Apply published error and distance thresholds to assess the feasibility of a proposed measurement.

Module 2. Scene examination and measurement

Module 2 addresses the examination and measurement of the scene. It covers preparation prior to attendance, the record produced on site, and the two principal routes by which scene geometry is measured.

On completion of this module, participants will be able to:

- Complete the scene examination workflow, from pre-attendance screening through to the site record.
- Apply the Site Examination Checklist, and account for environmental change occurring between the incident and the examination.
- Produce site photography to a standard suitable for disclosure.
- Apply reference measurements both to establish scale and to validate a solution.
- Describe the reverse projection method, and apply its methodology in the required sequence.
- Select between terrestrial laser scanning and on-site photogrammetric triangulation for a given scene.
- Capture a complete camera calibration image set, and state the purpose of each orientation within it.
- Assess control points for suitability, distribution, and continuing validity across the interval since the incident.
- Configure and apply a lens grid, and identify camera system anomalies from it.
- Conduct a height validation test against a known reference height.

Module 3. Point cloud data, photogrammetric principles and PhotoModeler

Module 3 covers the three-dimensional data used in the solution, the principles on which photogrammetric software operates, and the three workflows by which subject height is recovered. It is the largest module in the course and contains the majority of the practical work.

On completion of this module, participants will be able to:

- Describe the composition of a point cloud, and the measurement limits imposed by point spacing.
- Load, segment and measure point cloud data in CloudCompare, and fit a local ground plane with a reported RMS value.
- State the collinearity and coplanarity conditions, and their role in the photogrammetric solution.
- Distinguish interior from exterior orientation, and describe the function of bundle adjustment.
- Interpret residuals as a measure of internal consistency, and assess control point distribution.
- Complete a PhotoModeler project from image import, through marking and control assignment, to a validated camera solution.
- Recover subject height by triangulation from two synchronised images.
- Recover subject height by reverse projection against a best-fit ground plane.
- Recover subject height from a direct three-dimensional ground point with an applied vertical offset.
- Compare the three workflows by input requirement, precision and failure mode, and select between them for a given case.

Module 4. Statistics and uncertainty

Module 4 addresses the statistical treatment of repeated measurements. Height analysis across multiple frames produces a set of values rather than a single result, and this module covers the description of that set and the expression of the associated uncertainty.

On completion of this module, participants will be able to:

- Summarise a set of height measurements by central value and dispersion, calculated manually.
- Interpret standard deviation, and apply the normal distribution to a set of measurements.
- Express a height result as a range, and state the level of confidence that range carries.
- Distinguish random from systematic error, and identify the behaviour of each across repeated measurements.
- Combine independent uncertainty contributions in quadrature.
- Convert a pixel dimension into a measurement uncertainty.
- Conduct a known-height validation to identify systematic bias, and report the result.

Module 5. Biomechanics and frame selection

Module 5 provides the biomechanical basis for frame selection. Module 1 establishes midstance as the selection criterion; this module develops the capacity to identify it in recorded footage.

On completion of this module, participants will be able to:

- Define the gait cycle, and identify midstance within it.
- Determine gait phase from recorded footage.
- Account for stature variation occurring through the stride.
- Identify the head landmark, and specify in the report the point to which the measurement was taken.
- Report an apparent height inclusive of footwear, and document any applied offset together with its source.

- Rank candidate measurement frames by frame type and gait phase in combination.

Module 6. Courtroom communication

Module 6 addresses the communication of the result. It covers the structure and content of the report, the explanation of technical method in plain language, the expression of uncertainty, and conduct under cross-examination. A guest session on photogrammetry and the law is delivered within this module.

On completion of this module, participants will be able to:

- Explain photogrammetric method to a non-technical audience in plain language.
- Apply ACE-VR as an examination methodology, and distinguish it from report structure.
- Structure a report to the sections expected by LEVA, and to the minimum content specified by SWGDE.
- Describe the requirements of independent verification.
- Report a height as a bounded range, and justify each bound.
- Avoid expressions of conclusion unsupported by the underlying data, and apply a published scale of support.
- Disclose the material examined, the method applied, and the limitations of the result.
- Maintain a defensible position under cross-examination.

Module 7. Review and examination

Module 7 comprises review and assessment.

On completion of this module, participants will be able to:

- Review the methods taught across the course, and the basis on which each is selected.
- Complete a written examination.
- Complete a practical examination.

4. Hour-by-hour schedule

Each row states a scheduled session with its start and end time, its duration in hours, and the module from which the material is drawn. Practical sessions are shaded.

Day 1 Video integrity, compression, camera fundamentals and projection geometry

09:00 to 17:00 · 6.75 instructional hours

Time	Session	Hrs	Module
09:00 to 09:30	Course introduction	0.5	1
09:30 to 10:00	Course orientation and video data integrity	0.5	1
10:00 to 10:15	*Break*	*0.25*	
10:15 to 12:15	Video, spatial compression, temporal compression and artifacts	2	1
12:15 to 13:00	*Lunch*	*0.75*	
13:00 to 15:00	Camera fundamentals and lens distortion	2	1
15:00 to 15:15	*Break*	*0.25*	
15:15 to 16:00	Guided tutorials: distortion correction	0.75	1
16:00 to 17:00	Projection geometry	1	1

Day 2 Single-view measurement and scene examination

09:00 to 16:45 · 6.25 instructional hours

Time	Session	Hrs	Module
09:00 to 10:00	Single-view height analysis in Amped FIVE	1	1
10:00 to 10:15	*Break*	*0.25*	
10:15 to 11:15	Error, limits and application	1	1
11:15 to 11:45	Scene examination: the site, the workflow and the record	0.5	2
11:45 to 12:45	*Lunch*	*1*	
12:45 to 13:00	Reverse projection and overlay	0.25	2
13:00 to 13:15	Measurement methods: scanner and triangulation	0.25	2
13:15 to 13:30	Camera calibration tutorial	0.25	2
13:30 to 14:30	**Camera calibration, student exercise (practical)**	1	2
14:30 to 14:45	Camera calibration, PhotoModeler solve	0.25	2
14:45 to 15:15	Reconstruction from photographs: control points and the solve	0.5	2
15:15 to 15:30	*Break*	*0.25*	
15:30 to 16:00	**Reconstruction from photographs, student exercise (practical)**	0.5	2

Time	Session	Hrs	Module
16:00 to 16:30	Distortion correction without a site visit, and lens grids	0.5	2
16:30 to 16:45	Height validation and close	0.25	2

Day 3 Point cloud data, photogrammetric principles and initial solutions

09:00 to 17:15 · 6.75 instructional hours

Time	Session	Hrs	Module
09:00 to 09:30	Introduction to point clouds	0.5	3
09:30 to 09:45	Working in CloudCompare	0.25	3
09:45 to 10:45	**CloudCompare tutorial and point cleanup exercise (practical)**	1	3
10:45 to 11:00	*Break*	*0.25*	
11:00 to 11:30	How photogrammetry software works: triangulation	0.5	3
11:30 to 12:00	Camera resection and reverse projection	0.5	3
12:00 to 13:00	*Lunch*	*1*	
13:00 to 13:30	Getting started in PhotoModeler, lecture	0.5	3
13:30 to 14:00	Workflow 1: triangulation, lecture	0.5	3
14:00 to 15:30	**PhotoModeler triangulation exercise (practical)**	1.5	3
15:30 to 15:45	*Break*	*0.25*	
15:45 to 16:45	**PhotoModeler triangulation exercise 2, student self-directed (practical)**	1	3
16:45 to 17:15	Workflow 2: reverse projection, lecture	0.5	3

Day 4 Reverse projection, statistical treatment and legal context

09:00 to 18:00 · 6.75 instructional hours

Time	Session	Hrs	Module
09:00 to 10:00	**PhotoModeler reverse projection exercise 1, instructor-led (practical)**	1	3
10:00 to 10:15	*Break*	*0.25*	
10:15 to 11:00	*To be confirmed*	0.75	
11:00 to 12:00	**PhotoModeler reverse projection exercise 1, instructor-led, continued (practical)**	1	3
12:00 to 13:00	*Lunch*	*1*	
13:00 to 13:15	Workflow 3: direct 3D ground points, lecture	0.25	3

Time	Session	Hrs	Module
13:15 to 15:15	**PhotoModeler reverse projection exercise 2, student self-directed (practical)**	2	3
15:15 to 15:30	*Break*	*0.25*	
15:30 to 17:00	Statistics and uncertainty	1.5	4
17:00 to 18:00	Photogrammetry and the law (guest session, Jonathan Hak)	1	6

Day 5 Biomechanics, courtroom presentation and examination

09:00 to 15:30 · 5.5 instructional hours

Time	Session	Hrs	Module
09:00 to 09:30	Biomechanics, the gait cycle and its effect on stature	0.5	5
09:30 to 10:30	Courtroom communication	1	6
10:30 to 10:45	*Break*	*0.25*	
10:45 to 11:15	Review of concepts	0.5	7
11:15 to 12:00	*Lunch*	*0.75*	
12:00 to 13:00	Written examination, true/false and multiple choice	1	7
13:00 to 15:00	**Practical examination (practical)**	2	7
15:00 to 15:30	Closing remarks and course review	0.5	7

5. Notes on delivery

- Session times are those published in the course schedule. The duration shown for each session is the interval between its start and the start of the session following, so the sequence contains no gaps or overlaps.
- The Hrs column states the duration of every block so that each day reconciles. Meal periods and rest breaks are shown in italics and are not credited as instructional hours.
- Sessions identified as practical are completed by participants at a workstation. The remaining sessions are delivered as instruction, and include worked examples and directed discussion.
- Each participant requires a workstation with CloudCompare and PhotoModeler installed, and a camera with which to capture a calibration image set. Trial Licenses of required software will be provided but students are responsible for their own installation and trouble shooting.