

THE ZENMUSE P1™'S SMART OBLIQUE CAPTURE IS REVOLUTIONIZING OBLIQUE AERIAL PHOTOGRAPHY AND 3D MAPPING

Aerial Surveying Just Got Smart



Surveyors and GIS professionals have the highest standards when it comes to their tools and trade. It is therefore no wonder that many [surveyors are turning to drones](#) for their mapping and 3D modelling needs. Surveying drones consistently achieve results that meet [survey-grade accuracy standards](#), and they drastically reduce the time, cost and effort required in comparison with traditional surveying techniques.



Surveying with drones is more complicated than snapping [a few photographs from above](#). Several steps are required, from preparing [ground control points](#), to mission planning, to processing the images captured with [surveying software](#). Surveyors are often commissioned to produce high-resolution orthomosaics constructed with

photogrammetry techniques, or 3D models created with oblique cameras and 3D surveying techniques.



The P1 is compatible with DJI's Matrice 300 RTK, its latest commercial drone platform. Capable of six-directional sensing and positioning, 55 minutes of flight time and a 15km range, the M300 is a welcome new addition to any drone fleet.

With DJI's latest flagship surveying combo, the [Matrice 300 RTK \(M300 RTK\)](#) and the [Zenmuse P1](#) payload, surveyors have at their fingertips the ultimate surveying solution in terms of accuracy and efficiency. Thanks to the P1's Smart Oblique Capture (SOC) feature, surveyors can now capture and create 3D models of their targets more efficiently than ever before.

What is oblique photography?

In oblique photogrammetry, images are captured by several lenses mounted together in an array with fixed axis angles. The resulting images reveal details that are sometimes missed when only capturing vertical photographs, such as features occluded by vegetation or tall structures.

Oblique camera systems traditionally use a mechanical rig with five cameras in fixed positions in a cross configuration; one camera in the centre is surrounded by four other cameras, in front, behind, left and right, equally distanced at 90-degree intervals. This system places the central camera at an oblique angle where the 'nadir' angle (the point directly below the camera at ground level) is at a known, fixed point in the image.



An oblique camera payload.

Benefits of oblique photography

The requirements for accurate 3D models are ever-increasing. For example, 3D models are used in urban mapping for space

management, energy requirement analysis, traffic and pollution monitoring and disaster management. In surveying, an accurate 3D model can identify potential problems early in a project's timeline.

When compared with vertical aerial photography, oblique photography has many benefits. While a vertical angle can help show the placement of features like buildings, streets or open spaces in relation to each other, oblique aerial photos are better at providing perspective of features that rise from the ground, such as buildings, topography and foliage, in relation to the ground and horizon.

The benefits of oblique photography include:

- Images captured with an oblique camera reveal details that may otherwise have been obstructed in the vertical view by foliage or tall buildings.
- Oblique photography makes it easier to accurately determine the elevation of features when compared with vertical aerial photographs.
- As opposed to an orthographic setup, where the central camera looks directly down, the oblique system captures far more of the relative height data ahead of it. This also negates any lens distortion in all directions around the focal point, which the orthographic method may suffer from.
- Using multiple shots at controlled intervals, the position and relative height information gathered from each dataset can be compared, contrasted and amalgamated to give the relative height information between elements in the target area, producing a map of both position and height data, which can be rendered as a 3D map of the area surveyed.



DJI Terra creates detailed and accurate measurement results for high-resolution 2D orthomosaics and realistic, fully navigable 3D model reconstructions.

Limitations of oblique cameras

There are however disadvantages associated with traditional oblique camera arrays. Due to the number of lenses, the rig can be very heavy and expensive. A heavier payload means shorter flight times and more time spent swapping drone batteries, especially for larger surveying missions.

Furthermore, five flights are required if attempting oblique photogrammetry or 3D modelling with a single camera (nadir, FBLR), which takes significantly longer. People have therefore been searching for a new, lighter, quicker and more cost-effective solution for some time.

What is Smart Oblique Capture?

SOC is a new alternative process, exclusive to the [P1](#) and the [M300](#), that uses a single camera mounted on a gimbal to function as all five of the cameras in an oblique camera system. The [P1](#) is a 'traditional' camera (not an oblique camera) with a single lens, but can produce the same results thanks to elegant software.

When drawing the mapping area out on the DJI Pilot app (during mission planning), SOC automatically divides the target surveying area into sections. These sections denote how many photo angles are captured in this area. For example, sections in the centre of the surveying area get five photos, one at each angle (nadir, front, back, left and right). Sections at the periphery of the surveying area require fewer photos.

With SOC, because the photos in each 'set' of shots are not taken simultaneously, the position data, drone speed and gimbal direction are embedded in the metadata of each photo to compensate for the shift in position and perspective; similar to the mathematical calculations used to amalgamate the consecutive captures in an oblique camera array.

In this video, you will see that the dark green areas are only taking one side shot, purely for height data. The nadir shots are only captured in the yellow and light green areas and then at multiple points in the red designated target area, where the most information is required.

Once the survey is complete, post-processing software such as [DJI Terra](#) can be used to collate all the data and produce the 3D models required; the SD card can simply be plugged into a laptop to import the images for processing.

The datasets of shots (nadir, FBLR) are compared to each other, where the nadir shots are used to create a top-down 2D map. The directional shots from each position are compared to assign relative height information to the elements on the 2D map.

Surveying missions captured with the [M300 RTK](#) and [P1](#) can be processed using [DJI Terra](#), the all-in-one drone surveying software used to plan, visualize, process and analyse aerial photography. The application allows the user to quickly render and visualize the data in real time and reduces post-processing time. It creates detailed and accurate measurement results for high-resolution 2D orthomosaics and realistic, fully navigable 3D model reconstructions.



DJI M300 UAV equipped with P1 Gimbal.

Advantages of Smart Oblique Capture

- The P1 replaces the need for a multi-camera oblique system. This reduces weight and increases manoeuvrability and flexibility of deployment; being attached to a drone, as opposed to being connected to the hull of a larger aircraft, is a major benefit.
- SOC reduces the number of unnecessary photos captured. This means no time is wasted taking pictures at the periphery of the surveying target and less space and memory are used, resulting in a quicker processing time.
- Interchangeable camera lenses on the [P1](#) allow the swapping of lenses according to a project's needs. This is not achievable with a traditional oblique camera.
- In addition to the [M300's RTK](#) modules, SOC can take full advantage of [post-processing kinematics](#). In situations where RTK is unavailable, PPK is available because mission files are stored with original GNSS observations and TimeStamps.MRK files.

More about the [Zenmuse P1](#)

The [P1](#) is DJI's flagship photogrammetry and surveying payload. With a 45MP full-frame, low-noise, high-sensitivity sensor with interchangeable 24/35/50mm fixed-focus lenses on a three-axis stabilized gimbal, this is DJI's most powerful surveying camera to date. The P1 can take a photo every 0.7 seconds (with shutter speeds of up to 1/2,000th of a second) and can cover 3km² in a single flight.

Read more about the [P1](#)'s features [here](#).

The [P1](#) is compatible with [DJI's Matrice 300 RTK](#), its latest commercial drone platform. Capable of six-directional sensing and positioning, 55 minutes of flight time and a 15km range, the M300 is a welcome new addition to any drone fleet.

Get ahead, get smart

By cutting down on the number of images taken, SOC effectively reduces the in-air time of a mission and therefore the total surveying and mapping time. This has the added benefit of a subsequent 20–50% reduction in post-processing time.

With the increased use of drones in surveying, mapping and construction, there is a constant need for them to become simpler to use and more economical, in terms of both time and cost. SOC is one such innovation that covers both.



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