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Computer Vision Application: Photogrammetry

Description of Application: Photogrammetry is diverse field of techniques that compile visual data into composite images. One form, structures from motion (SfM), can approximate three-dimensional figures from an array of two-dimensional image sequences or video frames. SfM in computer vision is concerned with designing algorithms to execute these composites based on given data.

SfM photogrammetry is widely used for capturing large landscapes in geosciences, industrial site scouting, and cultural preservation. Any time a massive plot of land must be captured, SfM provides a method to combine many photos, usually taken by a drone, and merge them into a single image that can be further studied. The very highest scale of this example is Google Earth, where satellites have captured millions of photos of the surface to show a seamless global map texture.

Technology Behind It: Videos or image sequences are input to a motion algorithm where features are initially detected, typically in the x and y directions. These features – edges, corners, etc. – are tracked through each image or video frame so a three dimensional output can be generated. This output appears as though the individual pictures or video frames have been assembled into a single composite. When combined with LiDAR data, typically from drones flying over an objective, the three-dimensional output can be far more detailed, thanks to a third z direction providing range input.

Benefits and Challenges: A major benefit of SfM photogrammetry is its ability to recreate surveys and structures digitally. Any changes to these subjects can be thoroughly planned before expending resources in the field. The main challenges are related to a subject's specularity. Highly reflective materials perform poorly without otherwise sufficient data to generate a point cloud. Another major

challenge could be access to a particular area that needs to be captured, such as objects buried under dense vegetation. This can be overcome however with the use of LiDAR; the light rays can penetrate many layers of material to capture data without disturbing the terrain.

Reflection: Future developments are concerned with reproducing the internal structures of entire planets, starting with our Earth. As the technology becomes more widespread, many ancient sites can be explored to demystify long-forgotten cultures. On the other hand, these pervasive techniques could cause privacy concerns in our present.