MAPPINGMATTERS

YOUR QUESTIONS ANSWERED

The layman's perspective on technical theory and practical applications of mapping and GIS

BY Qassim A. Abdullah, PH.D., PLS, CP**

QUESTION:

Question: Do frame-based remote sensing systems, such as metric cameras, rely significantly on accurate inertial measurement unit (IMU) data with OPK (omega, phi, cappa) parameters for the creation of high-accuracy geospatial products? Or is position (XYZ) alone more important, as long as aerotriangulation can solve frame rotation during post-processing?

Nathan Eick, Flight Operations Manager,
Aerial Services, Inc. (ASI)

"Experience has shown us that while direct orientation sometimes achieves project accuracy, it fails to do so at other times."

Dr. Abdullah: My answer to your question Nathan is no, an aerial metric camera does not rely significantly on IMU orientation, as long as you are performing aerial triangulation on the imagery. For processing imagery, IMU has a significant advantage if you are using the direct orientation concept to bypass the process of aerial triangulation. However, you cannot always rely on the quality of the solution from the direct orientation for accurate mapping. Experience has shown us that while direct orientation sometimes achieves project accuracy, it fails to do so at other times. The concept of direct orientation hurts the most when you use it to set up stereo models for compilation. Some of these stereo pairs come clean and are free of parallax, while many other stereo models show severe parallax that hinders the completion of the map. That then begs the question, "What if I use high-end IMU that is very accurate in determining sensor orientation angles?" High-end IMU is sometimes more accurate than aerial triangulation in determining sensor orientation. However, modern imaging processes rely on multiple elements, including the camera, GPS receiver, IMU, camera mount, laptop, etc. The presence of parallax in some stereo pairs could be caused by a source other than IMU. When we put IMU on the digital camera, we are bolting the IMU hardware, i.e. box, to the camera body or the assembly that carries the lens. During aircraft takeoff and landing, not to mention soaring into the upper atmosphere, there are always mechanical and thermal stresses that cause vibration on and between these system components. While a good IMU measures accurate orientation angles of its body frame, these mechanical stresses may cause disruption in accurately transforming the orientation of the camera body and vice versa. Having accurate, IMU-derived orientation angles is always beneficial to the aerial triangulation solution as it can reduce the number of ground control points and it may accelerate the image matching process. However, the presence of IMU in aerial triangulation is not as important as utilizing accurate GPS positions. Having an accurate GPS position for each frame

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is crucial to processing imagery through aerial triangulation. This replaces the need to survey a tremendous amount of ground control points previously needed for the old practices of aerial triangulation prior to the invention of GPS. IMU can be handy for single flight-line corridor projects because it can reduce the amount of ground control points needed for processing the imagery. However, using high-end IMU for metric, large-format cameras can cost hundreds of thousands of dollars. This is why many of us in the industry stopped adding IMU to the camera after we experienced the problem of parallax with direct orientation. Utilizing accurate GPS positions and a few ground control points are all we need to perform successful aerial triangulation.

***Dr. Abdullah is Vice President and Chief Scientist at Woolpert, Inc. He is also adjunct professor at Penn State and the University of Maryland Baltimore County. Dr. Abdullah is ASPRS fellow and the recipient of the ASPRS Life Time Achievement Award and the Fairchild Photogrammetric Award.*

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