Commentary

From the Kelsh to the Digital Photogrammetric Workstation, and Beyond

Edward M. Mikhail
Purdue University

Every scientific or technical field undergoes continuous changes, and photogrammetry is no exception. These changes are caused by many factors, such as altered requirements, demands for new products, introduction of new tools, modification of existing equipment, and so on. Because photogrammetry is not a fundamental scientific discipline, but rather an applied technical field which relies on several basic disciplines, it is regularly impacted by advances in these disciplines.

Throughout its relatively short life, photogrammetry has experienced very significant changes caused by advances in optics, electronics, and imaging and computer technology. Those of us who have been photogrammetric educators for more than two decades, tend to be quite aware of these changes, particularly if we are true to our goal: to provide the students with education and training which prepares them for photogrammetry of the future, not only of the past and present. Although this is not easy, as it places a great demand for required educational resources, it is nevertheless mandatory.

In Purdue's Photogrammetric Analysis Laboratory there are, among other equipment, four systems: the Kelsh, Wild A7, Kern Analytical Plotter, and Digital Photogrammetric Workstations (DPW), including the GDE/HAI 770. It is reasonable to say that they represent the chronological generations of photogrammetric systems. Although some were developed before my time, the introduction of each system elicited both excitement and reluctance; each had its enthusiastic supporters and indifferent detractors. Many of us may well recall how much debate welcomed the analytical plotter, particularly by those who were in practice and who were very content and successful using optical/mechanical plotters. As a very young graduate student in the early 1960s, I could hardly control my excitement when I visited the National Research Council of Canada, and the great photogrammetric innovator, Dr. Uki Helava, introduced me to the concept of the analytical plotter. Its parts (viewer, step motors, electronic components, etc.) lay on his lab floor to be assembled! Because I was studying analytical photogrammetry, I could foresee how wonderful it would be to incorporate what I was learning into that new system.

Now, similar discussions are taking place with respect to the DPW. At least the analytical plotter had the potential advantage of doing away with a specialized instrument, the comparator, and still operated on a conventional hardcopy photograph. The DPW, on the other hand, imposes the additional requirement of digitizing the hardcopy photograph. So, as in the early 1970s when the photogrammetric community wrestled with the question of changing from analog to analytical, why, one now asks, should we change from analytical plotters to digital softcopy systems? Actually, "change" does not mean "replacement;" it is not appropriate to think of one replacing the other. The analytical plotter existed side by side with analog plotters, it performed most of their functions, but it also did more. The DPW must do no less, i.e., it should be capable of performing all of the tasks of the analytical plotter, as well as add more, in fact much more. My expectation of "much" more is based on the fact that the DPW rises to another level by dealing with digital imagery in addition to relying on digital computers.

Based on extensive studies performed at Purdue, all of the operations involved in the set-up of a photogrammetric model can be accomplished by an operator on the DPW to at least the same level of accuracy as on the analytical plotter. However, the added value of the DPW stems from working with digital imagery. Therefore, it makes more sense to automate these set-up processes. We have just finished testing, on several stereomodels, a newly implemented automated relative orientation, with automated blunder elimination, on the DPW. Not only does the entire operation take about one to two minutes, but it also is quite robust and produces high quality models with accuracies of 0.15 to 1.0 pixel. With regard to products, digital elevation models and the digital orthophoto have benefited substantially from the introduction of the DPW. Furthermore, fully automated photogrammetric triangulation is fast approaching the production level development.

Another significant value of softcopy systems is that they bring remote sensing and photogrammetric applications together on the same platform with great potential for mutual benefit. Rigorous sensor modeling, which photogrammetry demands, including direct incorporation of GPS data, can now benefit remote sensing. On the other hand, photogrammetric feature extraction would be markedly enhanced by automated remote sensing techniques. The DPW of the near future will be a 3D GIS workstation system whose database is a repository of photogrammetric, cartographic, and remote sensing data that are topologically consistent.

Increased speed, accuracy, and reliability, and reduced cost are the obvious expected benefits of softcopy photogrammetry. However, many other benefits can accrue if future photogrammetrists venture more into other fields seeking new applications beyond cartography and mapping. Real-time photogrammetry/remote sensing will become a reality. The young photogrammetrists entering the field are lucky in that they will have enormous opportunities. They must not, however, be detracted by those who think we will all soon become computer scientists! Photogrammetrists certainly need to learn much about this as well as other fields. But then they have been trained in these fields for nearly three decades. If one were to check the transcript of a Purdue graduate of 20 years ago, one would find that it contains courses in computer science, image processing, pattern recognition, and many others! These are supplements to, but not substitutes for, a thorough and fundamental understanding of photogrammetric principles and observations and their adjustment. The analytical plotter, DPW, precise target location by least squares, least-squares matching, the Forstner operator, feature-based photogrammetry, etc., were all introduced by photogrammetrists! There will be obstacles and problems to solve, but I have no doubt that digital/softcopy photogrammetry will continue to flourish and ultimately lead to real-time photogrammetry/remote sensing.