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Instant Grainification: Real-Time Grain-Size Analysis from Digital Images in the Field

D.M. Rubin, H. Chezar, P.L. Barnard, J.A. Warrick, and A.E. Draut

U.S. Geological Survey, Santa Cruz, California, USA (drubin@usgs.gov / Fax: 831-427-4748 / Phone: 831-427-4736)

Over the past few years, digital cameras and underwater housings have been developed to collect in-situ images of sand and gravel bed sediment, and software has been developed to determine grain size from the digital images (Rubin, 2004; Rubin et al., 2006). This approach is roughly 100 times as fast as traditional lab methods for grain-size analysis, enabling several hundred grain-size measurements per day.

In a comparison with more than 200 hundred grain sizes measured by traditional techniques (sieve and settling-tube analysis of grab samples), mean grain sizes calculated from spatial autocorrelation of digital images had a standard error of 6% (Barnard et al., 2007). Because the two approaches sample different populations of grains—photographic images only sample surface grains, whereas grab samples include subsurface grains—this 6% standard "error" is not entirely due to performance of the image-processing algorithm. To test algorithm performance alone, it is essential to eliminate differences between sample populations; for this purpose, grain sizes calculated from image analysis were compared with grain sizes measured by point counting of grains in the same images. Using this approach, the standard error decreased to 1%, demonstrating that differences between the image-analysis results and traditional lab methods are primarily due to real differences between populations of grains sampled by the two techniques; such differences in grain populations are a result of natural spatial variability (stratification) of sediment deposits.

Until now, all grain-size image processing was done back in the office, where images were uploaded from cameras and processed on desktop computers. Computer hardware is now small, powerful, and rugged enough to process images in the field, which allows real-time grain-size analysis. We present such a system consisting of a wireless digital camera, weatherproof tablet computer, and image-processing software (autocorrelation code of Rubin, 2004, running in Matlab). This system collects images and measures mean grain size of sediment on the bed or, when imaging a vertical outcrop such as the wall of a trench, the system calculates the vertical profile of grain sizes through a stratified deposit. In either case, the user aims the camera, pushes the shutter release, and waits less than 10 seconds for the results to be displayed on the computer.

References

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