SECTION 1. PROJECT ADMINISTRATIVE INFORMATION

• CDI Science Support Framework Element: Computational Tools and Services.
• Project title: **The 'Digital Grain Size' Web and Mobile-Computing Application.**
• USGS Cost Center: Southwest Biological Science Center, Flagstaff, Arizona.

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• Collaborating Investigator: **David Rubin**, Research Professor. *Dept. Earth & Planetary Sciences, University of California Santa Cruz*, Santa Cruz, CA. Tel: 1-831-459-4089. Email: drubin@ucsc.edu
• Collaborating Investigator: **Scott Wright**, Research Hydrologist. *California Water Science Center*, Sacramento, CA. Tel: 1-916-278-3000. Email: sawright@usgs.gov

• Measurement of sediment grain size is a fundamental requirement in a broad range of scientific disciplines. Increasingly, photographic images of sediment are being used to measure grain size, in place of traditional analyses of physical samples. There is particularly wide application in ecology, geology, astrogeology and hydrology. In recent years major advances have been made in the development of automated algorithms to provide highly accurate estimates of the grain size distribution of sediments within images (e.g. Buscombe et al., 2010; Buscombe, 2013). To consolidate these efforts and make these advances more accessible to greater numbers of scientists from any discipline, **we propose to develop a web-hosted application and mobile platform application for automatic analysis of images using the 'Digital Grain Size' (DGS) algorithm** (Buscombe, 2013). The user will use the website to 1) search for, download and/or upload sediment imagery; 2) launch a web application to upload and process their imagery on a cloud server, and download grain size distribution data in a number of formats; 3) download the application for use on computers, tablets and mobile devices for collection and analysis of sediment imagery 'off-line' in the field; 4) receive the latest developments in sediment imagery hardware and algorithm development; and 5) interact with the DGS wiki and user's forum.

SECTION 2. ESTIMATED BUDGET

Budget Category	Federal Funding "Requested"	Matching Funds "Proposed"
1. PERSONNEL (SALARIES including benefits):		
Federal personnel (salary for PI Buscombe, in-kind salary for CI Ralston and CI Wright):	$12,000	$11800
Non-federal personnel (in-kind salary for CI Rubin)		$7000
Contract software developer (225 hrs @ $100/hr):	$22,500	
Total Salaries:	$34,500	$18,800
2. TRAVEL EXPENSES:		
Travel for CDI workshop:	$1,000	
Travel and registration for scientific conference attendance:		$2,500
Total Travel Expenses:	$1,000	$2,500
3. OTHER DIRECT COSTS:		
Platform-as-a-Service (PaaS) cloud computing server	$2,500	
Publication costs	$1,000	$1,000
Total Other Direct Costs:	$3,500	$1,000
Total Direct Costs:	$39,000	$22,300
Indirect Costs (26 %):	$10,140	$0
GRAND TOTAL:	$49,140	$22,300

SECTION 3. PROJECT SUMMARY

Considerable effort has gone into developing algorithms for estimating grain size from images of sediment, because these methods allow collection of a far greater number of samples with much less effort and cost. The algorithm has worked well for a large range of sediment types and scientific disciplines. The cumulative result of these efforts to date is a software program "DGS" (Digital Grain Size). Due to high demand from researchers, this open-source software (written in Python and Matlab) is publicly available at http://dbuscombe-usgs.github.io/DGS_Project/. **We wish to respond to the growing popularity of the software by developing a set of powerful software tools to facilitate users' image collection and analysis needs**. We propose the following areas of work. **1) Develop a project website** with a USGS domain name: a 'one-stop-shop' for those interested in acquiring and analyzing sediment imagery. It would serve a number of roles, including: a) algorithm explanation how; b) 'best practices' for image collection; c) an online sediment image data repository; and d) a user forum for sharing experiences using the software and collecting sediment imagery, exchange ideas pertaining to the software, and foster collaborations. **2) Develop a web/mobile app to implement the DGS software** to estimate grain size-distribution from images of sediment. Accessed from the main project website, this user-friendly web-app would allow users to upload and analyze their sediment imagery, interact with the program and download the results in a variety of formats. The app would be based on the existing Python code, ported into a web framework to be deployed on a web server or in stand-alone mode. The website will allow tracking of software usage, and provide a consolidated, central, stable platform on which to develop the software by listening to end-user needs.

The project will be completed in 6 months during the following phases:

	Buscombe (PI)	**Ralston (CI)**	**Rubin (CI)**	**Wright (CI)**	**Contracted software developer**
Planning (1 month)	1 pp	½ pp	½ pp	½ pp	Approx. 10 hrs
Implementation (3 months)	0 pp	0 pp	0 pp	0 pp	Approx. 200 hrs
Testing and finalization (1 month)	1 pp	0 pp	0 pp	0 pp	Approx. 15 hrs
Dissemination (1 month)	1 pp	½ pp	½ pp	½ pp	Approx. 0 hrs
TOTAL:	3 pp	1 pp	1 pp	1 pp	225 hrs

During the **planning phase**, the PI will work with CIs and the software developer to design the website look and content, web app's user interface and mobile app. The software developer will port numerical Python code written by the PI into a web framework with a user-friendly interface using Flask (http://flask.pocoo.org) or Django (https://www.djangoproject.com/) running on a WSGI PAAS cloud computing platform. The mobile app will essentially be the same as the web app but with the added capability of specialized image capture (from integrated or peripheral cameras attached to the mobile device). During this phase the PI will write the website content. During the **implementation phase** the software developer will implement the planned software. During the **testing and finalization phase** the PI will liaise with the software developer to test, fix and refine the products on a variety of platforms. The PI, who is an accomplished Python programmer (https://github.com/dbuscombe-usgs), will be taught how the implement further changes to the apps. During the **dissemination phase** the PI and CIs will write a journal/magazine article and software instruction manual. The PI will contribute to the CDI annual report, and present the new tool at both a CDI Facilitators workshop and at an appropriate scientific conference.

References

Buscombe, D., Rubin, D.M., and Warrick, J.A., 2010, *Universal Approximation of Grain Size from Images of Non-Cohesive Sediment*. Journal of Geophysical Research - Earth Surface 115, F02015.

Buscombe, D. 2013, *Transferable wavelet method for grain-size distribution from images of sediment surfaces and thin sections, and other natural granular patterns*. Sedimentology, 60: 1709–1732.