USC Dornsife
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College of Letters, Arts and Sciences
Spatial Sciences Institute

May 29, 2018

Spatial Sciences Institute (USC Spatial) is now accepting applications for undergraduate student researchers to work with USC Spatial faculty on their funded research projects for the 2018-2019 academic year.

We are looking for students who have excellent academic records, show interest in participating in cutting-edge research projects at USC Spatial, and are eager to take advantage of the opportunity to work directly with faculty on their research projects.

Priority will be given to USC Dornsife Spatial Studies minors, Human Security and Geospatial Intelligence minors, and GeoDesign majors. However, applications from all majors, minors, and academic programs throughout the University are encouraged. Students of all class standing (including incoming freshmen or transfer students) are welcome to apply.

The research stipend is $11/hour, and the projects generally are structured for an average of 5 – 10 hours/week. **Accepted students will work out their specific work schedules for each semester with the supervising faculty or staff member and will be expected to honor the weekly time commitment for the duration of the academic year.**

USC Spatial student researchers are encouraged to submit their research work for presentation at events such as the Esri Geodesign Summit held in January in Redlands; the Spatial Science Institute's LA Geospatial Summit on February 22, 2019 in Los Angeles; the USC Undergraduate Symposium for Scholarly and Creative Work held in April on the USC campus; and the Esri User Conference held in July in San Diego. Students also are encouraged to submit their work to appropriate student research competitions, such as the 2019 USC Esri Developer Center Student of the Year Competition. Past student researchers have presented their results at international conferences such as the American Association of Geographers annual meeting, the SIGSPATIAL conference, and the United State Geospatial Intelligence Foundation GEOINT Symposium, and have contributed to published research.

To apply

Please provide:

- A resume which includes your name, contact information, major/minor, year in school, software and programming language competencies, and relevant course projects/skills;

- A current STARS report (not required for a new incoming student); and
- A statement of interest indicating the project(s) for which you are applying. You may apply for more than one project; please indicate the priority of your preferences. If selected, you will be selected for one project only.

Please email your complete application materials to Susan Kamei, Spatial Sciences Institute Managing Director, at kamei@usc.edu, by **5:00 p.m., Tuesday, July 31, 2018**.

Questions?

Please email Susan Kamei or call her at (213) 740-1375, or email Ken Watson, Spatial Sciences Institute Academic Programs Director, or call him at (213) 740-8298.

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Dr. Yao-Yi Chiang, Associate Professor (Research) of Spatial Sciences "Automatic Generation of Long-term and Large Geospatial Data from Historical Maps"

This project addresses a well-known problem among libraries, museums, and other cultural heritage institutions. Among the vast quantities of unprocessed collections held by data archives are large numbers of historic maps. Many are uncatalogued and stored in conditions that impede access. Only a small percentage are digitized, published online, and searchable by keywords. While the world is moving towards storing and displaying geographic information electronically, paper maps are still the most readily available geographic source that are carefully prepared by professionals. Paper maps also are very often the only source containing historical geographic datasets, such as the locations of underground gas pipelines and sewer systems built in the 1950s and abandoned oil wells, railroads, and mining sites. These datasets from historical maps are important for a variety of studies such as cancer and environmental epidemiology, urbanization, and landscape ecology. However, finding relevant maps is difficult, and the map content is not machine-readable. Today, converting geographic features in map images into a vector format (i.e., map digitization) is still a labor-intensive task.

Under the support in part from the 2017 USC Undergraduate Research Associates Program (URAP) and National Endowment for the Humanities, we are currently working in collaboration with the USC Digital Library and the Western Michigan University to generate metadata from collections of thousands of historical map scans automatically. We propose to build on our previous map processing software, Strabo, to support the efficient and accurate generation of metadata (e.g., the map location, publication date, publisher) from a large number of map scans. In 2017, we have built and tested a prototype system, and our work on generating meaningful phrases from individual map text achieved 79% to 92% precision and 33% to 44% recall on USGS and UK Ordnance Survey maps. The URAP supported student,

Haowen Lin, won first place in the ACM Student Research Competition (Undergraduate) at 2017 SIGSPATIAL Conference based on this work.

Student researchers in the 2018-2019 academic year will continue working on the project. They will help to develop algorithms, implement the algorithms in our current open source tools, and design and conduct a comprehensive experiment. The new challenges we are going to address this year is how to build a general algorithm and system that can handle a variety of map types with the minimal user intervention. The result will be software tools that allow libraries and map archives to efficiently and robustly build meaningful metadata from paper maps and make the maps easily discoverable.

The ideal candidates will have excellent academic records, are experienced in programming, and show interests in an advanced degree in either computer science or spatial sciences. Special considerations will be given to students of diverse backgrounds and female students in engineering and science.

Dr. Su Jin Lee, Lecturer of Spatial Sciences
"Impact of land use policy on urban development and human-environment systems change in Los Angeles County"

This research seeks to find spatial patterns of the single- and multi-family home values in Los Angeles County, California. Our research aims to identify quantitative parameters that affect the home values and to seek spatial relationships between the home values and the quantitative parameters using Geographic Information System and Science.

The research goals are to provide the spatially referenced quantitative parameters and to estimate spatial relationships using Ordinary Least Square and Geographically Weighted Regression models to understand why home values vary and what parameters contribute to higher home values. Hence, we will examine the locations of homes, the school quality, the rate of crimes, the accessibility to mass transits which are related to commuting styles, the proximity to restaurants and shopping centers, socio-demographic parameters, the environment, the air quality level, and so on. In addition, we try to understand how the home values have been spatially and temporally changed and how the parameters might have affected the changes.

This research will be executed in six main steps:

(1) literature review;
(2) collecting data that can be the potential parameters;
(3) manipulating the data;
(4) analyzing the data;
(5) testing the impact of the parameters with regression models and analyzing the results using ArcGIS and JMP; and

(6) producing a poster and writing a manuscript. This project will provide valuable research experience in designing a project, determining the fitness of use for data, creating properly specified regression models, and discussing the findings.

The ideal candidates will have taken SSCI 301, SSCI 382, and SSCI 383, or will have relevant GIS knowledge.

Dr. Travis Longcore, Assistant Professor of Architecture, Spatial Sciences, and Biological Sciences
"Coast Light: Actionable Science to Manage Coastal Nightscapes"

Leveraging a project funded by USC Sea Grant, student researchers will work to collect data on illumination levels at the shoreline in Los Angeles, Ventura, and Orange Counties and quantify lighting conditions at study sites for an experiment on the influence of night lighting on settlement rates of marine organisms. The two related parts of the project involve use of novel sources of remotely sensed data, data collection with a camera and software system to measure night light, and integration of results as relevant to coastal natural resource managers and designers.

The project addresses the three following questions:

(1) What is the range of nocturnal illumination experienced at the shoreline across Ventura, Los Angeles, and Orange counties?
(2) Do direct glare and sky glow influence the rate of settlement of marine invertebrate fouling organisms?
(3) Do ambient light conditions affect the geographic distribution of use of the urban coast by sensitive species such as Western Snowy Plovers and California Grunion?

Using newly deployed CubeSat satellites to image the coastal zone of Ventura, Los Angeles, and Orange counties at night and combining those data with ground-level measurements from the Sky Quality Camera and other remotely sensed information, we will develop models of light exposure at the land-water interface. We will undertake an experimental investigation of the settlement rates of marine organisms on submerged plates in a replicated paired control-impact, impact-control experiment at two locations with different sky glow levels. Finally, using data contributed to the project from ongoing survey efforts, we will measure shoreline lighting levels at important sites for Western Snowy Plovers and California Grunion and build habitat suitability models to investigate the role of light pollution in use of the southern California coast by these species. The overall project is scheduled for two years duration.

During the coming academic year, one student will work with CubeSat data to learn how to work with these remotely-sensed data and develop a database of other metrics of light pollution that can be used to understand the ground-based illumination levels. This student will also work as part of a team to do field work (along with a Ph.D. student and other project

personnel) to collect full-sky panoramas of lighting conditions on the Shoreline following a sampling scheme developed for the project.

The second student will participate in the experiment documenting settling rates of marine organisms under different light pollution conditions. This part of the project will be implemented in conjunction with Los Angeles County Museum of Natural History. We will set up experimental settling plates at two marinas and in differing experimental light conditions in each and quantify the settlement patterns of sessile marine organisms on the different plates. The experimental design will involve use of an over-the-counter dock light as a light source and a control site nearby, combined with two marina locations with differing localized light pollution. The first site will be at Cabrillo Beach Boat Ramp, next to the Port of Los Angeles, and the second is likely to be at Wrigley Marine Science Institute. At each site five replicate 20 cm by 20 cm plates will be submerged and affixed to the dock either under ambient conditions or under the dock light. After three months, the plates will be retrieved and cover of organisms photographed and quantified by number and percent cover (or percent cover only for clonal organisms). This process will be replicated. Organisms will be identified to the highest feasible taxonomic resolution, with common fouling organisms being a focus of particular attention.

The students, in close consultation with Dr. Longcore, will produce a multi-authored research poster describing the results of the project and present the poster at the Los Angeles Geospatial Summit (February 2019) and the USC Undergraduate Symposium for Scholarly and Creative Work (April 2019). They also may be contributed authors on research papers that emerge from the first year of this project, or that are written later using data collected or analyzed by the students.

Dr. Andrew Marx, Associate Professor of the Practice of Spatial Sciences
"Smallsat Human Security Monitoring System"

This project proposes to develop, validate and pilot the use of smallsat technology in the first human security monitoring system. Beginning in August 2017, constellations of small satellites provide daily imagery of the entire Earth's surface. While too coarse to detect individual people, cars or houses can be identified.

By leveraging recent developments in computer vision, time-series analysis and CyberGIS, this research will embark on an innovative, two semester project to detect and automatically alert users of human security threats such as urban floods, oil leaks or village burnings.

The undergraduate research assistants will undertake all aspects of the research project. Under the direct supervision of Dr. Marx, they will proceed through several steps:

- visually analyzing smallsat imagery (provided by Planet Research Program);
- identify candidate human security incidents for analysis with known dates;
- tweak existing Python code to download imagery and extract data;
- time-series analysis/statistical tests linking imagery data with known events;

- construct and conduct experiment (experimental and control groups);
- co-author a manuscript;
- combine with other student's events, and create a workflow for the automated downloading, analysis and alerting of these incidents; and
- publish a live (initially private) website displaying daily detected incidents.

Each undergraduate research assistant is expected to co-author a peer-reviewed manuscript with Dr. Marx on their analysis of a human security incident and produce a poster for presentation at a conference.

This research requires students to be comfortable and experienced working across academic units and disciplines. Specifically, the ideal candidates are students who can think in terms of time and space resolutions, but who also are experienced, or willing to learn, Python coding to analyze the thousands of daily images.

Dr. John P. Wilson, Professor of Spatial Sciences and Sociology, and Beau MacDonald, GIS Project Specialist
"'Superblocks' for Los Angeles? — Sustainable Urban Alternatives Evaluated with GeoDesign"

"Superblocks" are clusters of city blocks that contain people-oriented public spaces and single- or multi-family residences, bounded by arterial roads, with smaller interior streets where auto through-traffic is limited. Within superblocks, "quiet" streets with access restricted to local traffic and low speed limits help establish safer, walkable, bike-friendly communities with cleaner air. Hyperlocal economic opportunities for small-scale retail, coffee stands, or farmers' markets could be planned at intersections yet evolve as neighborhoods individually respond to new traffic patterns. Green spaces can be created or enhanced by planting trees, which residential neighborhoods have lost as infill redevelopment replaces buildings with smaller footprints (Lee et al. 2017). Supermarkets, stores, and other commercial ventures would still be located on peripheral collector or arterial roads, which would remain essential components of local and regional transportation networks.

Part of a new planning strategy implemented in Barcelona, these are placed within the existing urban fabric within neighborhoods across the city, with rerouted bus and bike lane systems integrated with the plan. More sustainable urban mobility and transformation of the city's relationship with cars are primary goals, and other objectives are equally ambitious: public space revitalization, increased biodiversity and urban green space, improved social interaction and cohesion, resource self-sufficiency, and promotion of local neighborhood governance. Better air quality is expected to be a major benefit.

Los Angeles streets in non-hillside communities are typically grids, like those in Barcelona, and could physically become superblocks without major modifications. A design guide (City of Los Angeles 2008) describes features within street network overlays, one of which is a

Neighborhood Enhanced Network "comprised of local streets that benefit from pedestrian and bicycle-related safety enhancements while preserving the connectivity of local streets to other enhanced networks." Amendments are expected as best practices change, indicating some municipalities would be open to new concepts. Within Los Angeles County, there are 88 incorporated communities, including the City of Los Angeles. Each is autonomous, but most have similar street and block designs. Block size and shape vary in the US and over the world. Barcelona blocks are square; superblocks are three-by-three squares. Los Angeles blocks are rectangles, which could cluster in a different manner to achieve the desired effect.

We propose to investigate the potential for creating superblocks within existing Los Angeles cities and communities. We propose to investigate these questions:

(1) Where are the best locations for proof-of-concept or pilot project neighborhoods?
(2) What is the potential for superblocks in Los Angeles?
(3) Could we reorganize our roads and streets to support a healthier population with a more-sustainable and equitable future?

Students will identify potential locations using various geospatial techniques and interdisciplinary skills that will require them to acquire, represent, organize, analyze, model, and visualize spatial information. Data-gathering, outreach, and other research will be done in local communities. Tools will include web- based survey and mapping tools and applications (e.g., Esri Survey 1-2-3, Collector, Web App Builder), along with various advanced techniques to create models.

Students on our research team work in an environment that emphasizes creative problem solving through collaborative effort and individual innovation, valuable skills for all future endeavors. They learn to collect and analyze data from multiple sources and develop a portfolio of work that enhances their future job placement. They employ a scientific paradigm to conduct primary research and learn about the process, including how to identify the problem, work on a team, and present their findings and creative accomplishments.

Data to create realistic models for the geodesign process will be obtained through student fieldwork, from existing geospatial data, and from community input. Students evaluate and update parameters, and build geodatabases to store information, and learn modeling and code-based cutting-edge technologies that enable the integration of information from multiple sources. Visualizations would begin with a small-scale digital model and then proceed to larger-scale detail with high levels of accuracy. The process is iterative with feedback loops for all members of the geodesign team.

This project is particularly well-suited for student research involvement, as students need to understand and apply underlying principles of geography, architecture, landscape architecture, urban planning, computer science, and spatial sciences. This research would be particularly appropriate for GeoDesign majors, but also would appeal to talented students from other disciplines, including environmental studies, mathematics, and earth sciences.

Dr. An-Min Wu, Lecturer of Spatial Sciences and Dr. Jill Johnston, Assistant Professor, Division of Environmental Health, Keck School of Medicine

"Assessing residential soil lead contamination using geospatial analysis in Southeast Los Angeles County, California"

Soil Pb in the urban environment has been linked to elevated blood Pb levels with long-term healtheffects to humans, especially to young children. Urban soil Pb levels are usually higher than background Pb levels due to historical usage of lead paint, leaded gasoline, and industrial activities. In the Los Angeles metropolitan area, soil Pb contamination has been a particular concern in Southeast Los Angeles near the old lead-acid battery smelter. The Exide smelter violated environmental regulations in releasing hazardous chemicals including lead and other heavy metals to air for several decades before closing down in early 2015.

The goal of our project is to understand spatial distributions of soil Pb levels in the proximity of the Exide facility subject to contamination using geographic information systems (GIS). We aim to answer the questions with the soil Pb data:

(1) develop approaches to identify neighborhood level exposures and hotspots within the community;
(2) understand the spatial autocorrelation of soil Pb samples at a fine spatial scale;
(3) conduct a sensitivity analysis of various statistical approaches to identify properties exceed state human risk guidelines.

Among the 8,497 parcels sampled as of February 12, 2018 in the Exide Clean Up Plan, we have acquired composite soil Pb samples in 1,527 unique residential parcel locations from California Department of Toxic Substances Control for our study area in Southeast Los Angeles County. Our proposed study area will be the Project Investigation Area (PIA) in the Final Clean Up Plan and Environmental Investigation Report (EIR). Approved by California Governor Brown in 2016, the Clean Up Plan expands testing and cleanup of residential properties, daycare centers, schools and parks with the PIA within 1.7 miles buffer from the previous Exide smelter. This PIA is generally bounded by State Route 60 to the north, Eastern Avenue to the east, East Gage Avenue to the south, and Santa Fe Avenue to the west in Southeast Los Angeles County. It includes six Los Angeles communities: Cities of Commerce, Bell, Maywood, Huntington Park, Boyle Heights (a City of Los Angeles neighborhood), and East Los Angeles (an unincorporated part of Los Angeles County).

The results of this study will facilitate further research in linking population and health relationships with soil Pb contamination in this urban environment, and will inform stakeholders for more effectively cleanup to reduce health risks to our local community.

The student researcher will work with us to learn how to handle imperfect datasets for proper spatial data analysis and visualization. Various methods of ESDA will allow us to understand the spatial characteristics and distributions of soil Pb levels, and sensitivity analysis will help us in prioritizing the contaminated parcels in these affected communities. In turn, the results of this

study will facilitate further research in linking population and health relationships with soil Pb contamination in this urban environment, and will inform policy makers and stakeholders for more effectively cleanup to reduce health risks to our community.

The student researcher will work with Dr. Johnston in Keck School of Medicine in understanding the sample data structure and handling data cleaning and processing for this important environmental contamination issue in our local community. The student will be working closely with Dr. Wu in the Spatial Sciences Institute to tackle GIS-related problem solving and geoprocessing. The student will learn to apply geospatial skills to understand spatial autocorrelation and spatial heterogeneity of the soil lead contamination in the study area.

The student will work on the proposed research for 9 hours per week on the task basis using ArcGIS, MS Excel, and R during Fall 2018 and Winter 2019. The student should be interested in environmental pollution and environmental health issues, have knowledge about GIS fundamentals and some experiences in ArcGIS (ideally to have taken one or two GIS-related courses by the start of Fall 2018 with an average GPA of 3.0 or above.

The student will start the project by meeting Dr. Johnston to understand source data structure and will work with Dr. Johnston for data handling, cleaning and management. Dr. Johnston will explain the important environmental background on this project. The student will then work with Dr. Wu in weekly basis at the Spatial Science Institute. Dr. Wu will provide guidelines for the GIS and statistical tasks and walk with the student through important concepts and techniques. The student will report project progress and discuss research problems encountered during the weekly meetings.

The student will be encouraged to attend the Spatial Sciences Institute Brown Bag seminar series and attend the Population, Health and Place (PHP) colloquia. The student also will be encouraged to attend the annual Los Angeles Geospatial Summit to network with other research students and faculty, and learn about emerging technologies and research projects in GIScience.