APPLICATIONS OF AIRBORNE IMAGING SPECTROMETER IN URBAN ENVIRONMENTS - OPPORTUNITIES AND CHALLENGES

Sunil Bhaskaran

Professor – CUNY &

Founding Director of BCC Geospatial Center of the CUNY CREST Institute

Sunil.Bhaskaran@bcc.cuny.edu

Examples of Applied Geospatial Technology. Imaging Spectroscopy in Urban Environment

Objective: Mapping roof types using airborne Imaging spectrometer and full-range field ASD…spectro-radiometers

Data – Airborne Imaging Spectrometer – HyMap

Study Area – Parts of North and South Sydney

HyMap is a airborne scanner developed by Integrated Spectronics, Australia. It has four Spectrometers in the 0.45 to 2.45 micrometers. Bandwidths are between 15 to 18 nanometers and spatial resolution is variable [3.5 to 10m]

Methodology

Sample Collection Roofing Materials

Extraction of Spectra

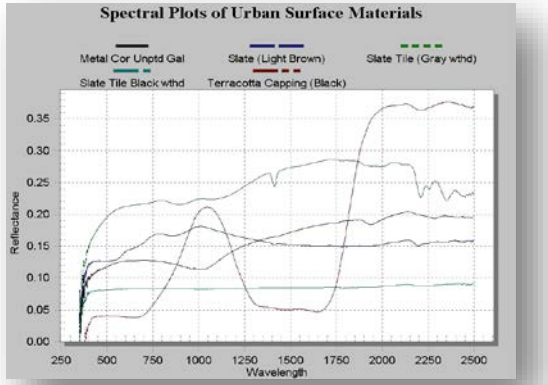
Spectral Plots and Interpretation

Resampling to HyMap Image Channel Configuration (126 Bands)

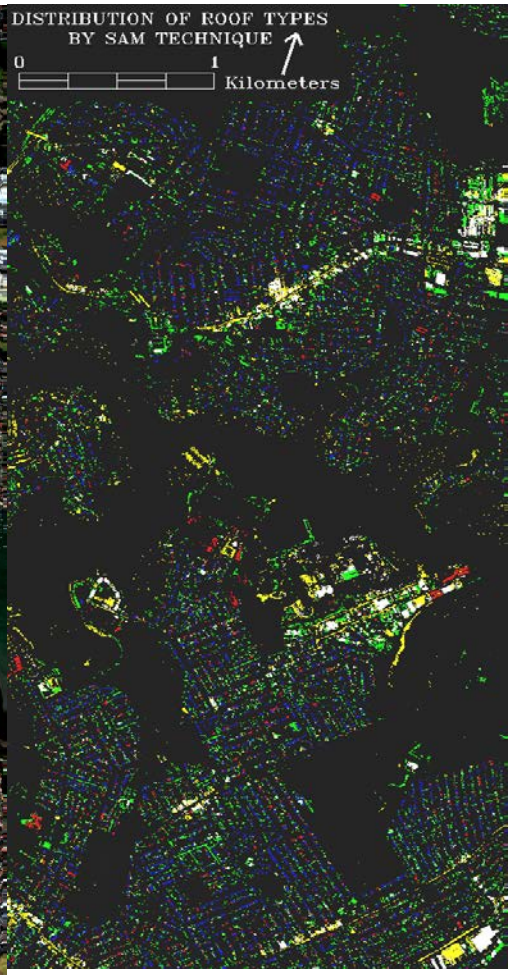
Empirical Line Technique

Radiance to Reflectance Conversion

Supervised Classification



Distribution Map - Roof types by material composition



The Sydney project beneficiaries

New South Wales Fire Brigades

CSIRO

Integrated Spectronics

Imaging Spectrometer Lab – University of Southern Queensland

University of Karlsruhe, Germany

Insurance Agency – SunCorp Metway Australia – Fraud Detection Project – Spectral and Object Based approaches [Quick Bird MSS and HyMap]

Mapping single terrestrial features using IS techniques

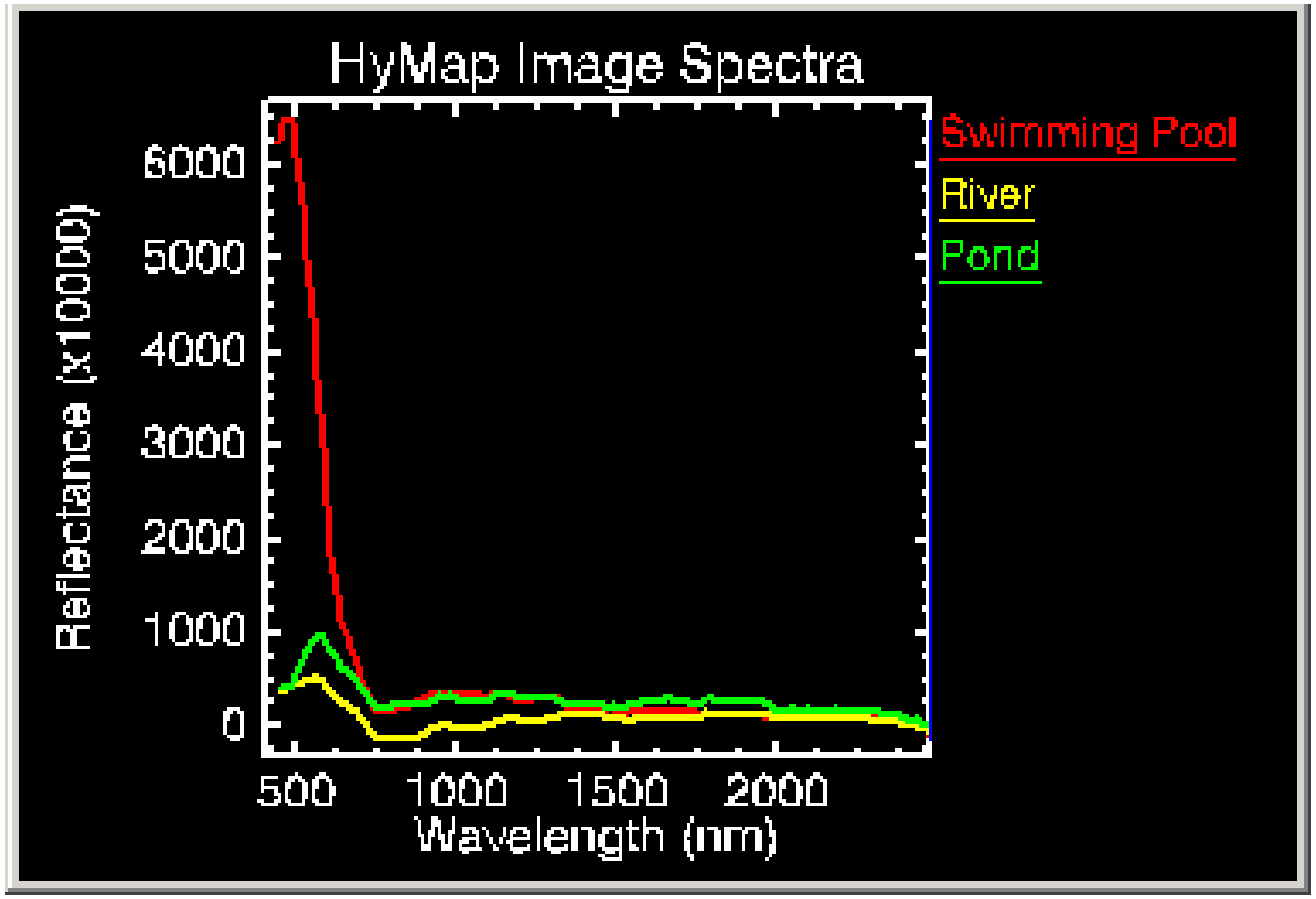
SWIMMING POOLS IN SYDNEY

TERRACOTTA ROOFS IN SYDNEY

Imaging spectrometer data also useful for extracting specific terrestrial features – Mapping Pools

Swimming Pool Identification results:

Swimming Pools generally have a very high reflectance (>20%) in the blue and green wavelengths whereas natural water bodies have low (<10%) reflectance in visible wavelengths (400nm to 700nm).
All water has zero reflectance in NIR (700nm to 1000nm) and SWIR (890nm -2420nm)



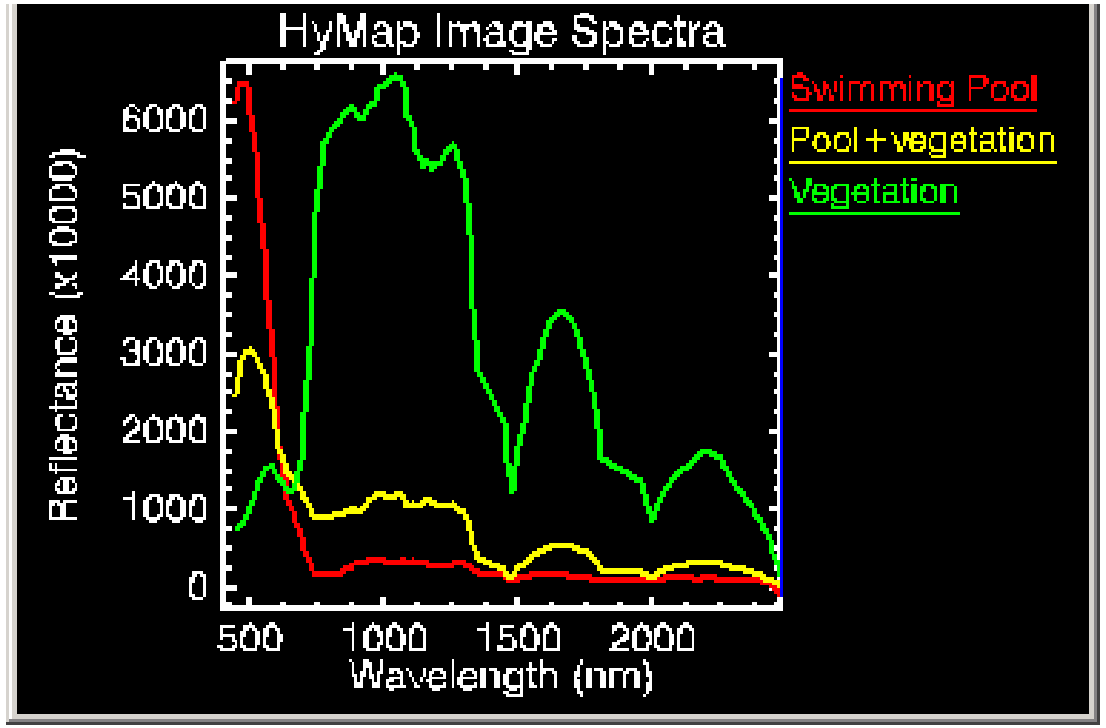
A Blue–Red index was used to separate water from other materials

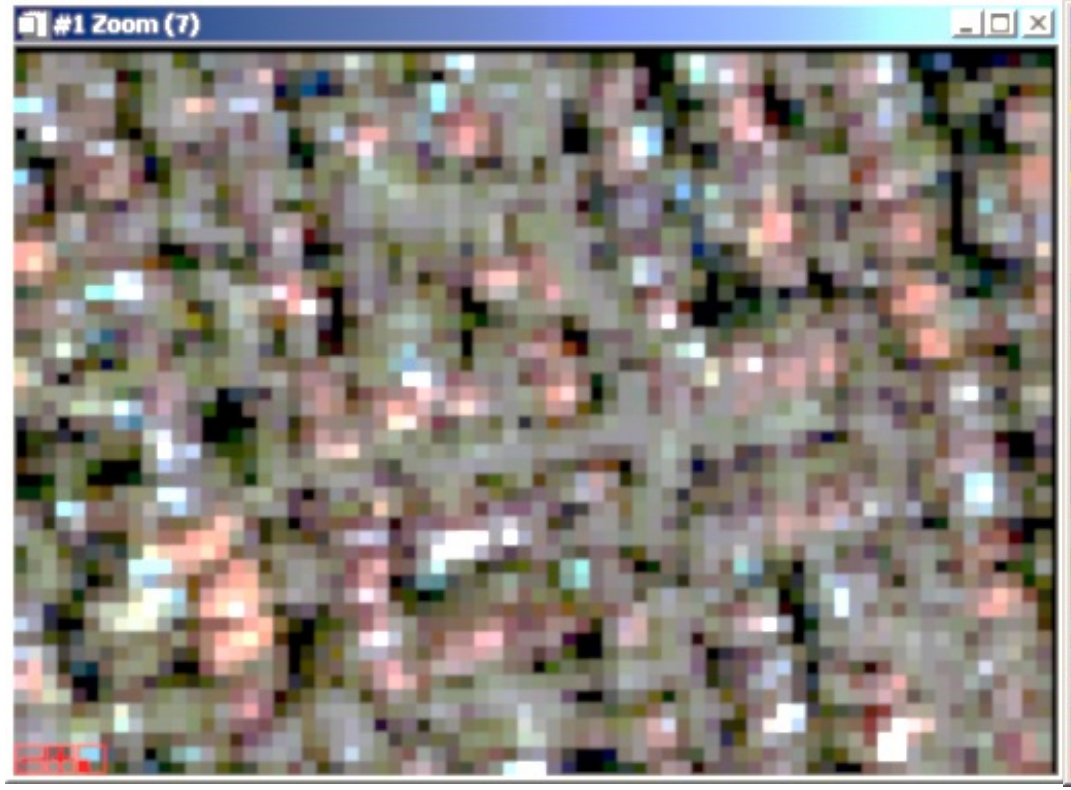
- **Blue–red index**

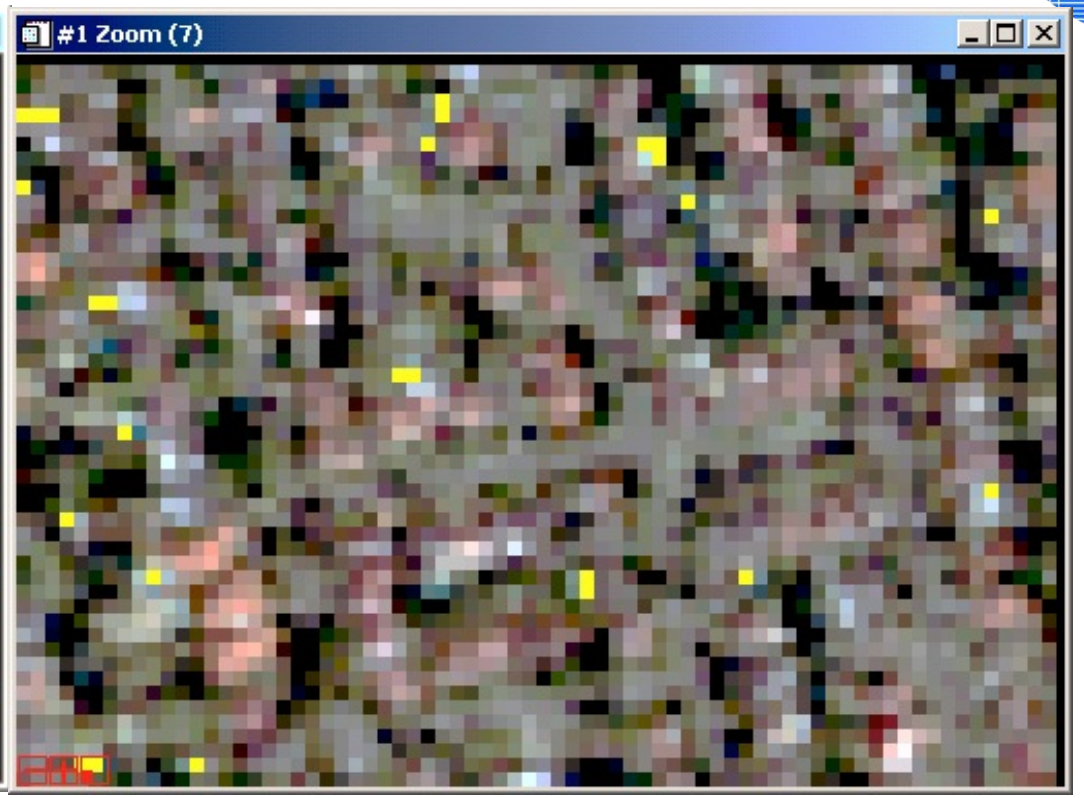
Blue-Red = R467nm - R667 nm
Blue+Red R467nm + R667 nm

Shows that reflectance values are +ve for water but -ve or near zero for all other materials. The Blue-Red index can also identify swimming pools in pure and also mixed pixels. To separate natural water bodies from pool we used a simple band math algorithm with thresholds or decision tree rules.

Blue-Red index >0.15
& Blue Reflectance > 10%







RGB Image showing pools

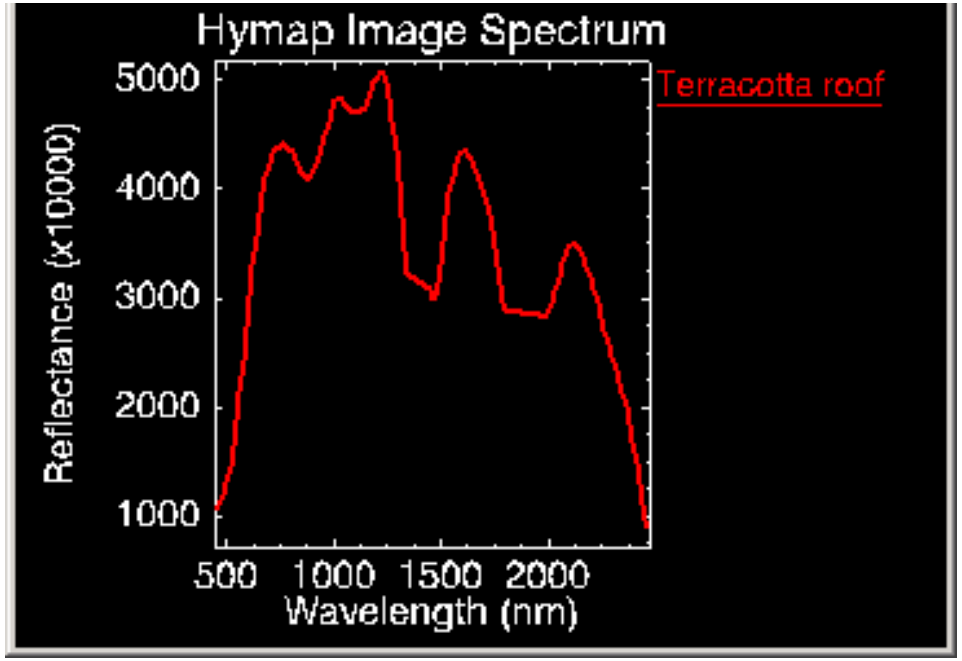
RGB image with extracted pool locations - Overlay [yellow]

Mapping terracotta roofs

Spectral footprints showing absorption features at 900nm.
A continuum is defined for each spectrum by finding the high points (local maxima) and fitting straight line segments between these points. The continuum was divided into the original spectrum to normalize the absorption bands to a common reference. A linear continuum removal was fitted between between bands 834nm and 958 nm**.**

Continuum removed (CR) spectrum obtained
1-CR = absorption depth
The absorption band area was defined by summing the depths of high absorption bands. Absorption depths summed across 834nm and 958 nm bands = absorption band area. Finally to separate the roofs and water, we used a band math function with the following conditions:

R530nm < R667nm ,
Absorption band area > 0.10



Terracotta Roofs Maps by using IS techniques

All residential property in the scene consists of terracotta were mapped with high percentage of accuracy.

All fairways, highways, commercial establishments, open land have not been classified

Results - Opportunities and Challenges

- A detailed roof map based on the materials was created over parts of Sydney.
- Imaging spectroscopy techniques may be used selectively to map specific terrestrial features.
- Imaging spectrometer data contains spectral content that may be integrated with spatial content by using object-based approaches

Challenges to use IS techniques in Urban Environments

- Urban environments are heterogeneous and characterized by mixed pixels – limits scope of using imaging spectroscopy data to map all features.

The BCC Geospatial Center of the CUNY CREST Institute Collaboration with Industry

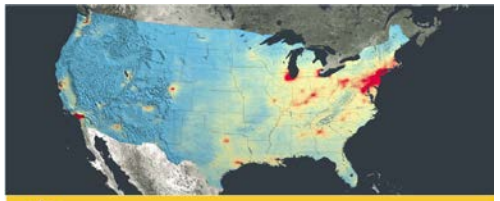
- The center has impacted students, faculty and other stake holders by promoting GT and has created opportunities for Industry – e.g. ESRI, Harris, Terrset, Tableau.

NSF-ATE –Pathways to Geospatial Technology and Careers

Activities 2017-Current – A CUNY – Industry Collaboration

CUNY The City University of New York

FALL 2017 & SPRING 2018



MAPPING AIR QUALITY IN NEW YORK CITY

Geospatial Technology Workshop for High School Students with stipends* [Funded by the National Science Foundation]

*Stipends are only awarded to participants who attend all the (10) workshops and successfully complete all assignments.

When: Every Saturday from 7th October to 9th December 2017, 1:00pm-4:00pm.
Where: Geospatial Computing Center, 330, Meister Hall, Bronx Community College. 2155, University Ave, Bronx, New York-10453

For additional information please contact
Dr. Sunil Bhaskaran [Professor and Director of BCC Geospatial Center]
Email: Sunil.Bhaskaran@bcc.cuny.edu
Tel: 718.289.5566/5523. Fax: 718-289-6448.
Geospatial Center Website: http://www.bcc.cuny.edu/geospatial/

PLANNING EMERGENCY MANAGEMENT WITH GIS

Geospatial Technology Workshop for Middle School Students with stipends* [Funded by the National Science Foundation]

*Stipends are only awarded to participants who attend all the (10) workshops and successfully complete all assignments.

When: Every Saturday from 7th October to 9th December 2017, 9:00am-12:00pm.
Where: Geospatial Computing Center, 330, Meister Hall, Bronx Community College. 2155, University Ave, Bronx, New York-10453

For Additional Information Please Contact
Dr. Sunil Bhaskaran [Director of BCC Geospatial Center]
Email Sunil.Bhaskaran@bcc.cuny.edu Tel: 718.289.5566/5523. Fax: 718-289-6448.
Geospatial Center Website: http://www.bcc.cuny.edu/geospatial/

SUMMER 2018

GEOSPATIAL WORKSHOP FOR HIGH SCHOOLS

PROPOSED ACTIVITIES

The geospatial center of excellence will work collaboratively with its partners and industry in organizing these workshops, which will consist of a combination of lectures, hands-on trainings and field activities including geospatial analytical tools, real-time water and air quality monitoring devices.

All participants will receive stipends upon successful completion of tasks

WHEN: July 2 — July 30

DAYS: Monday—Thursday 1pm—4pm

WHERE: Bronx Community College, Geospatial Computing Center, Meister Hall 330, 2155 University Ave, Bronx, NY 10453

SUMMER WORKSHOP INTERNSHIP PROGRAM FOR HIGH SCHOOLS

PROPOSED ACTIVITIES

Students will participate in
- research projects,
- present and publish in proceedings of conferences and
- learn to write journal articles.

All participants will receive stipends upon successful completion of tasks

WHEN: July 2 — Aug 8

DAYS: Monday —Thursday 9am– 4pm

WHERE: Bronx Community College, Geospatial Computing Center, Meister Hall 330, 2155 University Ave, Bronx, NY 10453

GEOSPATIAL WORKSHOP FOR MIDDLE SCHOOLS

PROPOSED ACTIVITIES

The geospatial center of excellence will work collaboratively with its partners and industry in organizing these workshops, which will consist of a combination of lectures, hands-on trainings and field activities including geospatial analytical tools, real-time water and air quality monitoring devices.

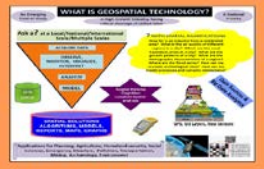
All participants will receive stipends upon successful completion of tasks

WHEN: July 2 — July 30

DAYS: Monday—Thursday 9am—12pm

WHERE: Bronx Community College, Geospatial Computing Center, Meister Hall 330, 2155 University Ave, Bronx, NY 10453

PROFESSIONAL DEVELOPMENT WORKSHOP FOR EDUCATORS FROM MIDDLE AND HIGH SCHOOLS AND COLLEGES



PROPOSED ACTIVITIES

The PDPs will be designed to improve the educators' disciplinary capabilities, teaching skills, and understanding of geospatial technologies. The training projects and modules will be prepared by using a place-based approach, which will enable them to learn fundamental geospatial skills and integrate these skills into their classroom lessons.

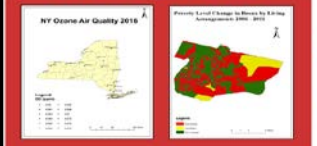
All participants will receive stipends upon successful completion of tasks

WHEN: Aug 6— Aug 16

DAYS: Monday —Thursday 9am — 4pm

WHERE: Bronx Community College, Geospatial Computing Center, Meister Hall 330, 2155 University Ave, Bronx, NY 10453

GEOSPATIAL WORKSHOP FOR COLLEGE STUDENTS



PROPOSED ACTIVITIES

The workshops will focus on problem-based learning techniques to address real-world problems, e.g., mapping and analyzing the patterns of invasive weed species, mapping the patterns of crime in an urban neighborhood, site selection for solid wastes in New York City, and other environmental applications of geospatial technology to different STEM disciplines.

All participants will receive stipends upon successful completion of tasks

WHEN: June 4— June 28

DAYS: Monday —Thursday 9am — 4pm

WHERE: Bronx Community College, Geospatial Computing Center, Meister Hall 330, 2155 University Ave, Bronx, NY 10453

SUMMER WORKSHOP INTERNSHIP PROGRAM FOR UNDERGRADUATES

PROPOSED ACTIVITIES

Students will participate in
- research projects,
- present and publish in proceedings of conferences and
- learn to write journal articles.

All participants will receive stipends upon successful completion of tasks

WHEN: June 4 — Aug 8

DAYS: Monday —Thursday 9am—4pm

WHERE: Bronx Community College, Geospatial Computing Center, Meister Hall 330, 2155 University Ave, Bronx, NY 10453

- ENTHUSE
- TRAIN
- MENTOR
- GUIDE
- INTERNSHIPS
- CAREERS

DR. SUNIL BHASKARAN EAS 2019

BUILDING AMERICA'S HUMAN CAPITAL ----------→ SKILLED GEOSPATIAL TECHNICIANS

City University of New York – Business Opportunities & Challenges

- Turn Over of > $1Billion
- Geospatial Technology for STEAM applications [***some disciplines depend on geospatial technology to be successfully taught and explained***!]
- There are opportunities for Industry to support CUNY with software and hardware, training and internships
- Example of BGCCCI – Since 2010 we have collaborated with Harris, ESRI, Terrset, Tableau

-→ resulted in skilled technicians, interns, employees, nurtured through out-of-the box Internships and regular exposure to the industry.


BCC Geospatial Center of the CUNY CREST Institute
Promoting excellence in geospatial education and research
THIS IS BRONX
ENTHUSE
TRAIN
MENTOR
GUIDE
INTERNSHIPS
CAREERS
JUST DO IT.

THANK YOU FOR YOUR PATIENCE - QUESTIONS