Course Outline

Asian Institute of Technology
School of Engineering and Technology

AT76.9042 Selected topic: Remote Sensing of Water 1(1-0) **Semester: August**

Course Objective: This course introduces the principles lying behind remote sensing of water, concentrating on water quality. Main objective of the course is to gain a basic and practical understanding, and linkages of remote sensing concepts with and coastal, estuarine, and inland water bodies. The major focus remains on practical knowledge over theories to learn how remote sensing tools and methods work. A variety of tools and techniques for real applications will be introduced through explained tutorials, including image interpretation, image enhancement, atmospheric corrections, band ratio, extraction of optically active constituents, and time series analysis. Participants will gain experience to download, handle and analyse data from variety of earth observation sources.

Learning Outcomes:
The students on the completion of this course would be able to:

1. Understanding of the interactions of radiation with the earth's water surface and atmosphere.
2. Understanding and applying best practices for advanced atmospheric correction and extraction of optical properties of water.
3. Understanding and basic interpretation skills, the strengths and limitations of remotes sensing-derived water quality and quantity products.

Prerequisite: None but the AT7603 Remote Sensing is preferable

Course Outline:

I. Principles of Remote Sensing & the Electromagnetic Spectrum
   1. Physical basis of remote sensing
   2. Electromagnetic radiation
   3. Energy sources
   4. Matter/energy interactions
   5. Spectral signatures of materials.
   6. Atmospheric corrections
      6.1 Principles of atmospheric correction: rigorous and empirical approaches
      6.2 Atmospheric Correction for Inland Waters
   7. Main satellites and sensors

II. Inherent Optical Properties of water and satellite-derived water parameters
   1. Remote Sensing of Inland Waters: Background and Current State-of-the-Art
   2. Bio-optical models (Current State-of-the-Art)
   3. Bio-optical modelling of water constituent
      3.1 CDOM
      3.2 Total Suspended Matter
      3.3 Chlorophyll-a
      3.4 Derived parameters link to clarity of water

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III. Explained tutorials.

1. Optical data pre-processing (data download, data fusion, rescaling, sub-setting)
2. Rigorous and NN-based atmospheric correction
3. Inherent, Optical Properties (IOPs) and water quality indicators estimation (Chl-a, TSM, CDOM and transparency mapping)
4. Field based validation and spatio-temporal analysis

Laboratory Session(s):

None

Learning Resources:

Textbooks: Lecture notes, tutorial and other ancillary learning resources will be provided (including online tutorials).

Reference Books:

Mishra, D. R., Ogashawara, I. and Gitelson, A. A.:
Bio-optical Modeling and Remote Sensing of Inland Waters, Elsevier, 2017.
Available online at:
https://www.sciencedirect.com/book/9780128046449/bio-optical-modeling-and-remote-sensing-of-inland-waters

John A. Richards:
Remote Sensing Digital Image Analysis - An Introduction (Fifth Edition), Springer-Verlag Berlin Heidelberg, 2013.
Available at:
https://link.springer.com/book/10.1007%2F978-3-642-30062-2

R. A. Schowengerdt:
Remote Sensing - Models and Methods for Image Processing (3rd Edition), (Third ed.). San Diego, California: Academic Press, 2007
Available, upon subscription at
https://www.sciencedirect.com/book/9780123694072/remote-sensing

Shunlin Liang and Jindi Wang:
Advanced Remote Sensing Terrestrial Information Extraction and Applications, (Second ed.), Elsevier, 2020.
Available at
https://www.sciencedirect.com/book/9780128158265/advanced-remote-sensing

Journals and Magazines:
Remote Sensing of Environment, Elsevier
Science of the Total Environment, Elsevier
Remote Sensing, MDPI
International Journal of Photogrammetry and Remote Sensing (ISPRS), Elsevier
Photogrammetric Engineering and Remote Sensing, ASPRS

Others: None

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Teaching and Learning Methods:

1. **Lectures**: Students will receive lecture notes and the weekly lecture schedule at the beginning of the course. They will be requested to read the lecture notes before coming to the class.
2. **Tutorials and Discussion Sessions**: Every class will have discussion sessions to engage all the students.
3. **Mini project**: Students will carry out mini-projects to show their ability to apply wate quality morning through remote sensing techniques in practice and problem solving. Data is provided and proposals are evaluated.

Time Distribution and Study Load:
Lecture: 15 Hrs.
Laboratory: none
Other self-studies = 50 Hrs.

Evaluation Scheme:

LO	Assessment method	% marks
All	Mini-project	50
All	Final-semester examination (close/open book)	50

In the examination, an

i. "A" would be awarded if a student shows excellent and insightful understanding of key concepts and advanced imagery processing techniques and master originally and sophisticatedly the knowledge learned in the class to obtain and analyse information on satellite-derived water quality indicators.
ii. "B+" would be awarded if a student shows very good understanding of key concepts and imagery processing techniques and master and elaborate the knowledge learned in the class to obtain and analyse information on satellite-derived water quality indicators.
iii. "B" would be awarded if a student shows a good understanding of all given topics and able to implement basic water-related satellite processing.
iv. "C+" would be given if a student meets below average expectation but may demonstrate some understanding on both knowledge and mastery of remote sensing of water concepts and techniques.
v. "C" would be given if a student meets fairly below average expectations and is deficient on both knowledge and mastery of remote sensing of water concepts and techniques.
vi. "D" would be awarded if a student does not meet basic expectations and is highly deficient on both knowledge and mastery of remotes sensing of water.
vii. "F" would be awarded if the student shows unsatisfactory and very limited comprehension of remote sensing of water concepts and processing techniques.

Instructor(s): Dr. Salvatore G.P. VIRDIS

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