Asian Institute of Technology
School of Engineering and Technology

AT76.28 ***Principles and Application of InSAR*** **1(1-0)** **Semester: August**

Course Objective: The objectives of this course are: i) to provide background knowledge and understanding of principles of InSAR; iii) to acquire skills on basic InSAR and DInSAR image processing and analysis as well as basic knowledge on main limitations and error sources of these techniques; iv) to enable critical, spatial and temporal thinking on InSAR for real-world applications.

Learning Outcomes:

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

1. Evaluate critically the principles of INSAR and DInSAR systems
2. Search and download relevant SAR data required for a certain InSAR and DInSAR –based project/purpose.
3. Perform basic signal processing techniques for InSAR and DInSAR imaging using publicly available software packages and SAR data.
4. Visually interpret in a qualitative way InSAR and DInSAR output images and interferograms.
5. Gain insight into the strengths and limitations InSAR and DInSAR systems and applications.

Prerequisite: None

Course Outline:

I. Synthetic Aperture Radar (SAR) principles and Image Acquisition
   1. Key features of satellite radar systems
   2. Amplitude and phase information
   3. Range resolution, signal compression and formation of a range line
   4. Acquisition geometry and synthetic aperture
   5. SAR images
   6. Geometric distortions and satellite orbit
   7. Scattering mechanisms

II. SAR Interferometry
   1. Measuring phase variations
   2. Modelling the interferometric phase
   3. SAR interferograms
   4. Phase decorrelation and coherence maps
   5. Atmospheric effects
   6. Phase Unwrapping

III. Multi-interferogram techniques
1. Historical background
2. Time series approach
3. Estimation of 2-dimensional displacement fields
4. Precision assessment and validation

IV. SAR, InSAR and DInSAR applications in geosciences.
1. Floods mapping
2. Surface displacement mapping (earthquakes, volcanos, subsidence etc.)

Tutorial(s):

1. SAR Basic Tutorial with Sentinel-1 Toolbox and Radarsat-2 data.
2. InSAR Tutorial with Sentinel-1 Toolbox and Radarsat-2 data: digital elevation model production.
3. DInSAR Tutorial with Sentinel-1 Toolbox and Sentinel-1 data: earthquake displacement mapping.

Learning Resources:

Textbooks: No designated textbook, lecture notes, handouts and other ancillary learning resources will be provided.

Reference Books:

Alessandro Ferretti
Satellite InSAR data: reservoir monitoring from space. EAGE Publications bv, 2014.

Bert M. Kampes
Radar Interferometry: Persistent Scatterer Technique. Springer Publishing Company, Incorporated, 2006.

Ramon F. Hanssen
Radar Interferometry: Data Interpretation and Error Analysis. Remote Sensing and Digital Image Processing, Vol. 2. Kluwer Academic Publishers, 2001.

Journals and Magazines:

Remote Sensing, MDPI
International Journal of Photogrammetry and Remote Sensing (ISPRS), Elsevier
Photogrammetric Engineering and Remote Sensing, ASPRS
Remote Sensing of Environment, Elsevier

Others: None

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**: Tutorials will expose students to different tools in SAR imaging. Instructor will provide a basic guideline for student to learn and familiarize with Radar Interferometry software and data. Students are requested to understand the algorithm of each operation so that they are able to operate with other software. Students will be requested to complete home assignments and submit a report in due time.
3. **Discussion Sessions**: Every class will have discussion sessions to engage all the students.

Time Distribution and Study Load:

Lecture: 10 Hrs
Tutorials: 15 Hrs
Self-study: 40 Hrs

Evaluation Scheme:

Tutorials: 50%
Final exam (closed book): 50%
The final grade will be based on the following weight distribution: tutorials (50), final exam (50%). An "A" would be awarded if a student can elaborate the knowledge learned in class by giving his/her own analysis on real case examples given in this course and from journal articles and including assigned readings. A "B" would be awarded if a student shows an overall understanding of all given topics, a "C" would be given if a student meets below average expectation on both knowledge acquired and analysis. A "D" would be given if a student does not meet basis expectations in understanding and analyzing the topics and issues presented in the course.

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