

SIO 135/SIO 236 Satellite Remote Sensing

We will explore the fundamental concepts, methodologies, and applications of satellite-based Earth observation systems. This course will equip students with the essential knowledge and skills to effectively use satellite data for environmental monitoring, resource management, and scientific research. Overall, we will explore the full electromagnetic spectrum to understand the basics of many satellite remote sensing techniques, and discover their immense potential in understanding our dynamic planet.



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Guest lecturer: Dr Yao Yu

Guest lecturer for Week 1: Prof David Sandwell

TA: Chancellor Roberts ccroberts@ucsd.edu

Lectures: MWF 11:00-11:50, 100 Vaughan Hall, in person (some recordings from 2021 in Media Gallery)

Lab Sessions: T 1:00-3:00, F 12:00-2:00, Eckart 225 - recordings from 2021 (in Media Gallery)

Office Hours: by appointment, send e-mail, Lab sections/TA office hours: TBA

Homework discussion by zoom: Time TBD.

Grading: SIO 135 Homework/Labs (60%), Midterm (20%), Final (20%)
SIO236 Homework/Labs (50%), Midterm (20%), Term Paper (30%)

Citations for Homework: Feel free to use information found in books or on the internet. Be sure to add a short citation to information you have gathered. This could be a short citation such as [Miller and others, JGR, 1978] or a hyperlink to the paper or web page. You can use ChatGPT but please make a note on when it was used. We are interested to know if it is a good learning tool for this class.

Grading of Homework and Labs: Most problems (easy or difficult) are graded on a 10 point scale. Working in groups on homework and labs is encouraged but do your own work in the end. We will check for identical answers and computer codes with 0 points for identical answers. There will be a deduction for late homework (10% for one day and a maximum of 30% for 3 days or more).

REQUIRED TEXT:

Rees, W. G. TITLE **Physical principles of remote sensing SECOND OR THIRD EDITION**, Cambridge University Press, 2013., 440 p.,

[Free book access](#) and download after VPN connection to UCSD.

WEB MATERIAL:

Textbook web site, Solutions to Chapter Problems > Resources > Solutions

[NASA Missions](#)

[NASA Science](#)

[NASA's WorldView](#)

[ESAS 2017 Decadal Survey Report](#)

OTHER TEXT BOOKS:

Massom, R., D. Lubin, Polar Remote Sensing, V II: Ice Sheets, Springer Verlag, 426 pp., 2006.

Elachi, Charles **Introduction to the physics and techniques of remote sensing** /Charles Elachi. New York : Wiley, c1987. xvii, 413 p., [16] p. of plates : ill. (some col.) ; 26 cm. Wiley series in remote sensing. NOTE "A Wiley-Interscience publication." Includes bibliographies and index. ISBN 0471848107.

Stewart, Robert H. **Methods of satellite oceanography** / Robert H. Stewart. Berkeley : University of California Press, c1985. DESCRIPTION viii, 360 p., [16] p. of plates : ill. (some col.) ; 27 cm. SERIES Scripps studies in earth and ocean sciences. 1. Includes index. Bibliography: p. [329]-351. ISBN 0520042263. Astronautics in oceanography.

Gonzalez, Rafael C. **Digital Image processing using MATLAB** / Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins. Upper Saddle River, N. J. : Pearson Prentice Hall, c2004. UCB Engin TA1632 .G66 2004

Gonzalez, Rafael C. **Digital image processing** / Rafael C. Gonzalez, Richard C. Woods. PUBLISHED Reading, Mass. : Addison-Wesley, c1992. DESCRIPTION xvi, 716 p.. [8] p. of plates : ill. (some col.) ; 24 cm. NOTE Includes bibliographical references (p. 683-703) and index. ISBN 0201508036. SUBJECT Image processing --Digital techniques. Woods, Richard C.

Richards, J. A. (John Alan), 1945- **Remote sensing digital image analysis : an introduction** / John A. Richards. 2nd rev. and enlarged ed. Berlin ; New York : Springer-Verlag, c1993. xx, 340 p. : ill. (some col.) ; 25 cm. ncludes bibliographical references and index. ISBN 3540548408 (Berlin : acid-free paper) 0387548408 (New York : acid-free paper) Remote sensing.

WEEK 1	Introduction	Reading	Assignment	Instructor
Monday 1st April	Introduction to course Overview of remote sensing	Rees 1.1-1.4 Appendix	HW1	Sandwell/Fricker
Weds 3rd April	Overview continued Lab 0 discussion			Sandwell/Roberts
Friday 5th April	Platforms and orbits Use of color in remote sensing	Rees 10.1-10.4 Notes on orbits		Sandwell
LAB	Download & install MATLAB or Python		LAB 0	
WEEK 2	EM radiation & GPS			
Monday 8th April	Electromagnetic (AM) radiation, polarization	Rees 2.1-2.2 EM Summary	HW2	Fricker
Weds 10th April	Lecture continued Lab 1 discussion			Fricker Roberts
Friday 12th April	GPS and the ionosphere Intro to Fourier transforms	Rees 2.3		Yao Yu/Fricker
LAB	MATLAB basics, plotting		LAB 1	
WEEK 3	Fourier Transforms & Thermal Radiation			
Monday 15th April	Spectra and Fourier transforms Diffraction	Rees. 2.7 Fourier notes	HW3	Yao Yu/Fricker
Weds 17th April	Lab 2 discussion			Roberts
Friday 19th April	Thermal radiation	Rees. 2.5-2.6 notes on radiation		Fricker
LAB	1-D and 2-D Fourier transforms		LAB 2	

WEEK 4	Propagation, dispersion and scattering; image processing			
Monday 25 April	Propagation, dispersion, and atmospheric scattering	Rees 3.1, 3.3	HW4	Fricker
Weds 27 April	Surface scattering Lab 3 discussion	Rees 3.5		Fricker Roberts
Friday 29 April	Image Processing - 1	Rees 11.1-11.2		Yao Yu
LAB	Data Types		LAB 3	
WEEK 5	Image Processing			
Monday 01 May	Image Processing - 2	Rees 11.3-11.4		Yao Yu
Weds 03 May	Lab 5 discussion	Rees 5.1-5.3	HW5	Roberts Yao Yu Fricker
Friday 05 May	Stereo Notes/Examples Optical imagery, CORONA, MODIS Satellite Design	Rees 5.4-5.5		Fricker/Yao Yu
LAB	Image Processing		LAB 4	
WEEK 6	Midterm review and exam			
Monday 06 May	Passive microwave systems & applications			
Weds 08 May	Review and go over HW 1-5 Practice Midterm			Roberts
Friday 10 May	Midterm exam			
WEEK 7	Imagery and radar altimetry			
Monday 13 May	Image classification	Rees 7.1-7.4	HW6	Yao Yu

Weds 15 May	Image classification contd Machine learning Lab 6 discussion			Roberts
Friday 17 May	Satellite radar altimetry	Rees 8.1 - 8.3		Fricker
LAB	Google Earth Engine		LAB 5	
WEEK 8	Radar & laser altimetry; SAR			
Monday 20 May	Satellite radar & laser altimetry			Fricker
Weds 22 May	Satellite laser altimetry Lab 7 discussion		HW7	Fricker Roberts
Friday 24 May	Synthetic Aperture Radar (SAR)	Rees 9.1 - 9.3		Yao Yu
LAB	Image Classification		LAB 6	
WEEK 9	SAR & applications			
27 May	*** Memorial Day Holiday ***			
29 May	SAR Interferometry Lab 8 discussion	Rees 9.4-9.5		Yao Yu
31 May	SAR for solid earth & cryosphere			Yao Yu/Fricker
LAB	Laser and Radar Altimetry		LAB 7	
WEEK 10	Review			
LAB	SAR Interferometry		LAB 8 (optional)	