FLORIDA ATLANTIC UNIVERSITY	**NEW COURSE PROPOSAL** **Graduate Programs**	UGPC Approval _____ UFS Approval _____ SCNS Submittal _____ Confirmed _____ Banner Posted _____ Catalog _____
	Department Biological Sciences **College** College of Science *(To obtain a course number, contact **erudolph@fau.edu**)*	

Prefix EVS **Number** 5385	*(L = Lab Course; C = Combined Lecture/Lab; add if appropriate)* **Lab Code**	**Course Title** Image and Video Processing and Vision in Marine Environment
Credits *(Review Provost Memorandum)* 3 **Effective Date** *(TERM & YEAR)* FALL 2017 ~~Spring 2018~~	**Grading** *(Select One Option)* **Regular** ◉ **Sat/UnSat** ○	**Course Description** *(Syllabus must be attached; see Guidelines)* Course studies the fundamentals of electro-optical image and video processing in the underwater environment. Covers topics such as underwater image and video enhancement techniques, underwater stereo vision, and emerging underwater imaging system concepts.

Prerequisites Introduction to Digital Signal Processing (EEL4510); or consent of instructor	**Corequisites**	**Registration Controls** *(Major, College, Level)*

Prerequisites, Corequisites and Registration Controls are enforced for all sections of course

Minimum qualifications needed to teach course: Member of the FAU graduate faculty and has a terminal degree in the subject area (or a closely related field.)	**List textbook information in syllabus or here** Digital Image Processing", R.C. Gonzalez and R.E. Woods, III Edition, Upper Saddle River, NJ:Prentice-Hall 2008
Faculty Contact/Email/Phone Dr. Bing Ouyang bouyang@fau.edu (772) 242-2288	**List/Attach comments from departments affected by new course**

Approved by		***Date***
Department Chair	R.K. [illegible]	12-6-16
College Curriculum Chair	[illegible]	Dec 5/16
College Dean	Dr. Charles Roberts	Dec 5, 2016
UGPC Chair	Wm R McNamee	12-14-2016
Graduate College Dean	Paul R Pfeiffer	12-14-16
UFS President	[illegible]	
Provost		

Email this form and syllabus to UGPC@fau.edu one week before the UGPC meeting.

Course Syllabi for Image and Video Processing and Vision in Marine Environment

1. **Course title/number, number of credit hours**

Image and Video Processing and Vision in Marine Environment – EVS 5385 –

3 credit hours

2. **Course prerequisites**

   a. Introduction to Digital Signal Processing (EEL4510) or equivalent

   or

   b. Permission of the instructor.

3. **Course logistics**

   a. Term –Fall 2017
   b. Notation if online course – N/A
   c. Class location and time (if classroom-based course) – To be determined

4. **Instructor contact information**

   a. Instructor's name – Bing Ouyang
   b. Office address – HBOI Link Building Rm 130
   c. Office hours – To be determined
   d. Contact telephone number – office (772) 242-2288, fax (772) 242-2257
   e. E-mail address – bouyang@fau.edu

5. **TA contact information (if applicable)**

   N/A

6. **Course description**

   This course will expose the students to the fundamentals of electro-optical image and video processing in the underwater environment. Potential topics include the basics of image and video processing and computer vision, underwater image and video enhancement techniques, underwater stereo vision, and emerging underwater imaging system concepts.

7. **Course objectives/student learning outcomes**

   This course introduces the fundamentals of image/video processing and computer vision techniques and how to apply these techniques to improve the performance of underwater imaging systems and enhance the subsea visibility.

   - Gain basic understanding of image and video process and computer vision;
   - Gain basic knowledge of the effective techniques to enhance and restore the underwater electro-optical imagery.
   - Gain basic level understanding of the application of some new signal processing concepts such as the compressive sensing theory in the underwater electro-optical system design.

8. **Course evaluation method**

There will be graded homework assignments accounting for 30% of the student's cumulative performance, a term project that accounts for 30% of the student's cumulative performance, a first exam that accounts for 15% of the student's cumulative performance, and a second exam that accounts for 25% of the cumulative performance. The overall grade in the course is derived from the cumulative performance according to the following table.

9. **Course grading scale (optional)**

Cumulative Performance	Grade
>94%	A
>90% - 94%	A-
>87% - 90%	B+
>83% - 87%	B
>80% - 83%	B-
>75% - 80%	C+
>65% - 75%	C
>60% - 65%	C-
>57% - 60%	D+
>53% - 57%	D
>50% - 53%	D-
<50%	F

10. **Policy on makeup tests, late work, and incompletes**

If a student cannot attend an exam or hand in a homework project on time due to circumstances beyond their control then the instructor may assign appropriate make-up work. Students will not be penalized for absences due to participation in University-approved activities, including athletic or scholastics teams, musical and theatrical performances, and debate activities. These students will be allowed to make up missed work without any reduction in the student's final course grade. Reasonable accommodation will also be made for students participating in a religious observance. Also, note that grades of Incomplete ("I") are reserved for students who are passing a course but have not completed all the required work because of exceptional circumstances. A grade of "I" will only be given under certain conditions and in accordance with the academic policies and regulations put forward in FAU's University Catalog. The student must show exceptional circumstances why requirements cannot be met. A request for an incomplete grade has to be made in writing with supporting documentation, where appropriate.

11. **Special course requirements (if applicable)**

N/A

12. **Classroom etiquette policy (if applicable)**

University policy on the use of electronic devices states: "In order to enhance and maintain a productive atmosphere for education, personal communication

devices, such as cellular telephones and pagers, are to be disabled in class sessions."

13. Disability policy statement

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodation due to a disability to properly execute coursework must register with Student Accessibility Services (SAS) [formerly the Office for Students with Disabilities (OSD)] - in Boca Raton, SU 133 (561-297-3880); in Davie, MOD 1 (954-236-1222); in Jupiter, SR 117 (561-799- 8585); or at the Treasure Coast, CO 128 (772-873-3305) - and follow all SAS procedures. The SAS site is http://www.fau.edu/sas/

14. Honor Code policy statement

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty, including cheating and plagiarism, is considered a serious breach of these ethical standards, because it interferes with the University mission to provide a high quality education in which no student enjoys an unfair advantage over any other. Academic dishonesty is also destructive of the University community, which is grounded in a system of mutual trust and places high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. For more information, see University Regulation 4.001 at http://www.fau.edu/regulations/chapter4/Reg_4.001_5-26-10_FINAL.pdf

15. Required texts/readings

Required textbook: Digital Image Processing", R.C. Gonzalez and R.E. Woods, III Edition, Upper Saddle River, NJ:Prentice-Hall 2008;

Required readings:

1. J. S. Jaffe "Computer Modeling and the Design of Optimal Underwater Imaging-Systems", IEEE Journal of Oceanic Engineering, 1990.
2. F.M. Caimi, D.M. Kocak, F.R. Dalgleish, and J. Watson, "Underwater Imaging and Optics: Recent Advances", IEEE Oceans'08, pp. 1-9, 2008.
3. F. R. Dalgleish, A. K.Vuorenkoski, G. Nootz, B. Ouyang, and F. M. Caimi, "Experimental imaging performance evaluation for alternate configurations of undersea pulsed laser serial imagers", Proc., SPIE 8030, 2011.
4. W. Hou, D. J. Greay, A. D. Weidemann, G. R. Fournier, and J. L. Forand "Automated underwater image restoration and retrieval of related optical properties.," IEEE IGARSS, pp. 1889-1892, 2007.
5. N. Carlevaris-Bianco, A. Mohan, and R. M. Eustice, "Initial results in underwater single image dehazing", IEEE Oceans'10, pp 1-8, 2010.
6. J. W. Kaeli, H. Singh, C. Murphy, and C. Kunz, "Improving color correction for underwater image surveys", IEEE Oceans'11, pp. 1-6, 2011.

7. B. Ouyang, F. R. Dalgleish, F. M. Caimi, A. K. Vuorenkoski, T. E. Giddings, and J. J. Shirron "Image enhancement for underwater pulsed laser line scan imaging system", Proc SPIE 8372, 2012.
8. H. Li, X. Wang, T. Bai, W. Jin, Y. Huang, and K. Ding, "Speckle noise suppression of range gated underwater imaging system", Proc. SPIE 7443, 2009.
9. F. R. Dalgleish, F. M. Caimi, W. B. Britton, and C. F. Andren, "Improved LLS imaging performance in scattering-dominant waters," SPIE, Vol. 7317, 2009.
10. L. Mullen, A. Laux, B. Cochenour, E. P. Zege, L. L. Katsev, and A. S. Prikhach, "Demodulation techniques for the amplitude modulated laser imager" Appl. Opt., vol. 46, pp. 7374-7383, 2007.
11. M. Levoy and P. Hanrahan, "Light Field Rendering," Proc. SIGGRAPH'96, pp. 31–42, 1996.
12. B. Ouyang, F. R. Dalgleish, A. K. Vuorenkoski, W. Britton, B. Ramos, and B. Metzger, "Visualization for multi-static underwater LLS system using Image based Rendering", IEEE Journal of Oceanic Engineering, Vol. 38, pp. 566 – 580, 2013.
13. R.G. Baraniuk, "Compressive sensing," IEEE Signal Processing Mag., vol. 24, no. 4, pp. 118–120, 124, 2007.
14. M. F. Duarte, M. A. Davenport, D. Takhar, J. N. Laska, T. Sun, K. F. Kelly, and R. G. Baraniuk, "Single-pixel imaging via compressive sampling", IEEE Signal Processing Magazine, vol. 25, no. 2, pp 83-91.
15. B. Ouyang , F. R. Dalgleish , F. M. Caimi , T. E. Giddings , J. J. Shirron , A. K. Vuorenkoski , W. Britton , B. Metzger , B. Ramos , and G. Nootz, "Compressive Sensing Underwater Laser Serial Imaging System", Journal of Electronic Imaging, special edition on Compressive Sensing, Vol. 22, Issue 2, 2013.

16. Supplementary/recommended readings (optional)

- J. Watson and O. Zielinski, "Subsea optics and imaging", Woodhead Publishing, 2013.
- W. Hou, "Ocean Sensing and Monitoring: Optics and Other Methods", SPIE Press, 2013.
- R. C. Gonzalez, R, E. Woods, and S. L. Eddins, "Digital Image Processing Using MATLAB", Prentice Hall, 2004.
- G. Bradski, A. Kaehler, "Learning OpenCV", Oreilly & Associates Inc, 2008.
- I. E. Richardson, "H.264 and MPEG-4 Video Compression," John Wiley & Sons, September 2003.
- E. Trucco and A. Verri, "Introductory Techniques for 3-D Computer Vision," Prentice-Hall, Inc., Upper Saddle River, New Jersey, 1998.
- R. Hartley, A. Zisserman, "Multiple View Geometry in Computer Vision," Cambridge University Press; 2 edition, 2004.

17. Course topical outline

	Topics	Homework
1	Image representation (sampling, quantization)	Homework assignment 1: (Programming) Set up programming environment (Matlab/OpenCV); basic image and video import/export
2	Visual perception and color spaces	Write the term project proposal
3	Overview of passive and active underwater electro-optical systems	Review papers [1-3]
4	Image probability density models	Homework assignment 2: (Programming) image noise
5	Spatial domain and transform domain image filtering	Homework assignment 3: textbook problems on image filtering
6	Advanced underwater image enhancement and restoration 1: passive imaging systems;	Review papers [4 - 6]
7	Advanced underwater image enhancement and restoration 2: active imaging systems;	Review papers [7 - 10]
8	Image feature extraction and image mosaic	Prepare for the first exam
9	Image and video compression	Homework assignment 4: (Programming) image compression
10	Video noise reduction	Homework assignment 5: (Programming) video enhancement
11	Motion analysis and object recognition	Homework assignment 6: (Programming) object detection from underwater video
12	Passive underwater stereo vision	Homework assignment 7: (Programming) calibration of stereo imaging system
13	Active underwater stereo vision	Homework assignment 8: (Programming) Structured lighting stereo vision in underwater environment
14	Image based rendering in underwater vision	Review papers [11,12]
15	Introduction to the compressive sensing theory	Review papers [13 - 15]
16	Compressive sensing based underwater imaging system	Preparing for the second exam and complete term project

Helen Randall

From: Peter McCarthy
Sent: Tuesday, November 01, 2016 8:18 AM
To: Megan Davis; Sarah Milton; Helen Randall
Subject: FW: Email of support for Harbor Branch Courses

Here is the letter (e-mail) of support from Engineering. Charles sent it to Sarah and me on October 12th.

Peter

From: Charles Roberts
Sent: Wednesday, October 12, 2016 9:02 AM
To: Sarah Milton <smilton@fau.edu>; Peter McCarthy <PMCCART5@fau.edu>
Subject: Re: Email of support for Harbor Branch Courses

Here is the support letter from Engineering. All the conditions listed have been met.

Charles

From: Javad Hashemi
Sent: Monday, September 22, 2014 10:39:07 AM
To: Charles Roberts
Cc: Tsung-Chow Su
Subject: RE: Email of support for Harbor Branch Courses

Dear Charles, thank you for attending a meeting with the OE faculty regarding various issues that you highlighted in your email below. I would like to provide a synopsis for our discussions as follows:

1- The OME department is very supportive of the Marine Science Degree plan. We believe that the degree plan will be very successful and this will be great for FAU and all of us. We are however concerned that it could influence some of the engineering students to switch fields in the middle of their Masters of Ocean Engineering studies to pursue the newly formed, more descriptive, Marine Science Degree. You suggested that, to allay the faculty's concerns, you will add language to your degree plan guidelines requiring students that engage in such a transfer "to start their degree plan in the Marine Science Degree anew" (no credits will be transferred from their OE plan). This suggestion works for OME.
2- Regarding the courses that you wish to add (see table below), the OME graduate committee has reviewed them and has concluded that there are no overlaps. Therefore, we feel that the OE program can give its blessing for your program to offer these courses. We do request, however, that these courses be offered out of the Geosciences Department instead of OME. The graduate committee felt that these courses are of the applied nature for the end-user. There is minimal

technology development content and therefore not uniquely suitable for engineering. We do believe that these courses are valuable and engineering students should be able to take them as graduate electives, perhaps joint listing will be an option.

OCE 6269	Marine Optics	Dalgleish, Anni
OCE 6267	Underwater Optical Imaging for Marine Scientists	Dalgleish, Fraser
EVS 5385	Image and Video Processing and Vision in Marine Environment	Ouyang
OCE 6680	Ocean Monitoring Systems and Implementation Strategies	Cherubin, Dalgleish, Dalgleish

3- Regarding affiliated faculty status for HBOI researchers, we are very open to this suggestion and encourage it however we feel that the affiliated faculty designation should be possible in both directions; HBOI scientists may be affiliated with the OME program and OME engineering scientists may be affiliated with HBOI. We should jointly (with HBOI) define the concept of "affiliated faculty" to avoid any potential future disagreements regarding voting rights, tenure privileges, financial responsibilities, student advising and support, proposal writing and budgeting issues. I realize that this may sound a little excessive but we feel it necessary, for clarity purposes, nevertheless. The OME program faculty would like to postpone the offering of such designations to HBOI scientists until we have discussed the matter for a mutually agreeable definition and process.

Please contact me if you have any questions or comments about the above summary.

Thank you and regards,

Javad Hashemi

From: Charles Roberts
Sent: Thursday, August 21, 2014 9:51 AM
To: Javad Hashemi; Ali Zilouchian
Subject: Email of support for Harbor Branch Courses

Good Morning,

Last spring we spoke about these three course proposals from the engineers at HBOI:

OCE 6267 Underwater Optical Engineering

OCE 6269 Marine Optics

OCE 6680 Ocean Monitoring

At the time you indicated that you would support the courses, but wanted them to adjust the website, which I believe they have done. You had reservations about the Marine Science Degree, which we will work on this fall, and I will ask for your comments and concerns and eventually support as we develop the program. I would however, like to take the three courses we discussed through the curriculum process now, so I am asking for an email indicating your support.

Dr. Charles Roberts
Interim Chair, Department of Geosciences and
Associate Dean of Graduate Studies
Charles E Schmidt College of Science
Florida Atlantic University