Subject Description Form

Subject Code	LSGI549
Subject Title	Advanced Photogrammetry and Computer Vision
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	The aims of this subject are to provide fundamental and depth knowledge of the topics in the area of photogrammetry and computer vision. The development of the fundamental mathematical models and study of advanced techniques will allow students to be equipped with the knowledge and practical skills. This subject also emphasizes training students with the latest developments in photogrammetry and computer vision for problem-solving.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: a. derive the mathematical models for 2D and 3D coordinate transformations, collinearity, and coplanarity b. design, execute and evaluate aerotriangulation and bundle adjustment based photogrammetric projects using digital photogrammetric systems c. demonstrate a basic understanding of the various digital image processing techniques and the automation of digital photogrammetric processes d. understand the related developments in the computer vision field for 3D reconstruction e. manage and implement a photogrammetric 3D mapping project including field data collection and data processing using typical digital photogrammetric software systems
Subject Synopsis/ Indicative Syllabus	• **Fundamental concepts and mathematical models in photogrammetry** (Coordinate transformation, collinearity, coplanarity, aerotriangulation, bundle adjustment, etc.) • **Photogrammetric project planning** (Parallel and convergent imaging geometry, parallel axis projects, convergent axis projects) • **Digital photogrammetry** (Digital image processing, interest operators, image matching, automation of photogrammetric operations) • **Computer vision for 3D reconstruction** (structure from motion, multi-view stereo, shape from shading, machine learning for image processing)

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- **Advanced topics in photogrammetry and computer vision** (UAV oblique photogrammetry, SLAM, etc.)

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<tr><td>Teaching/Learning Methodology</td><td>Students will obtain the theories and methodologies in normal lectures. Students will then gain the practical experience through well-designed lab practices. Demonstrations of various hardware and software will be given. Advanced software will be demonstrated to show students the direction photogrammetric development is heading. Tutorials will be used to address specific learning problems and to fill-in identified knowledge gaps. A group project will then follow to develop students' high-level cognitive understanding and integration of knowledge.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="5">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a.</td><td>b.</td><td>c.</td><td>d.</td><td>e.</td></tr>
<tr><td>1. Assignment</td><td>40%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>2. Group projects</td><td>20%</td><td></td><td>✓</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>3. Final test</td><td>40%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="5"></td></tr>
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Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Continuous assessment will be used to assess students' understanding of methods and techniques involved in photogrammetry. Lab assignments and group projects will test how well the students can use the skills and tools (e.g., photogrammetric software) to handle data and solve practical 3D mapping problems. A written examination will test students' knowledge of various technologies and how to use these technologies under different environments.
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<tr><td rowspan="6">Student Study Effort Expected</td><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lecture</td><td>26 Hrs.</td></tr>
<tr><td>▪ Tutorial</td><td>13 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Self-study, reading and practical</td><td>66 Hrs.</td></tr>
</table>

	Total student study effort:	105 Hrs.
Reading List and References	Kraus, K. (1993). Photogrammetry volume 1: fundamentals and standard processes. Ferd. Dümmler Verlag, Bonn. TR693 .K6213 1993 Kraus, K. (1997). Photogrammetry volume 2: advanced methods and applications. Ferd. Dümmler Verlag, Bonn. TR693 .K6213 1993 Linder, W. (2006). Digital photogrammetry. A practical course. Springer-Verlag, Berlin. Luhmann, T., S. Robson, S. Kyle and I. Harley (2006). Close range photogrammetry. Principles, methods and applications. Whittles, Caithness. TR693 .L84 2006 Merritt, L. (1997). 3D modeling from photos. 3DC Press, Elizabethton. TR693.M47 1997 Moffitt, F.H., and E.M. Mikhail (1980). Photogrammetry. Harper & Row, New York. TA593 .M58 1980 Sandau, R. (ed) (2010). Digital airborne camera. Introduction and technology. Springer, Dordrecht. TA593.35 .D55 2010eb Schonberger, J.L., and J. M. Frahm (2016), Structure-from-Motion Revisited, Proceedings of the 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), doi: 10.1109/CVPR.2016.445 Vosselman, G. and H-G. Maas (2010). Airborne and terrestrial laser scanning. Whittles, Caithness. G70.6 .A37 2010 Wu, B. (2017). Photogrammetry - 3D from Imagery, In D. Richardson, N. Castree, M. F. Goodchild, A. Kobayashi, W. Liu, and R. A. Marston (Ed.): The International Encyclopedia of Geography, John Wiley & Sons, Ltd., New York, pp. 1-13 Wu, B., W.C. Liu, A. Grumpe, and C. Wöhler (2017). Construction of Pixel-Level Resolution DEMs from Monocular Images by Shape and Albedo from Shading Constrained with Low-Resolution DEM. ISPRS Journal of Photogrammetry and Remote Sensing, doi: 10.1016/j.isprsjprs.2017.03.007 **Journals** *ISPRS Journal of Photogrammetry and Remote Sensing*. Elsevier, Amsterdam. TA593 .P52 *Photogrammetric Engineering and Remote Sensing*. American Society of Photogrammetry, Falls Church. TA593 .P54 *Photogrammetric Record. Photogrammetric Society*, London. TR693 .P46	