Subject Description Form

Subject Code	COMP6706
Subject Title	Advanced Topics in Visual Computing
Credit Value	3
Level	6
Pre-requisite / Co-requisite/ Exclusion	Nil.
Objectives	This subject aims to equip the students with the comprehensive and in-depth knowledge and the state-of-art technologies in the field of visual computing which cover advanced mathematical theory, new algorithms and diversity of applications to solve real-life problems in the relevant areas including computer graphics, image processing, computer vision, multimedia systems, scientific visualization and virtual reality.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: (a) Understand the fundamental issues and challenges in visual computing, in particular the relationship of the advanced topics in visual computing to today's fast growing information technology; (b) Get familiar with the relevant advanced mathematical theories for visual information modeling, representation, analysis, understanding and synthesis; (c) Obtain the algorithmic principles on different aspects of visual computing and extend them to develop innovative visual systems for various applications; and (d) Apply visual information technology to solve a wide range of practical problems.
Subject Synopsis/ Indicative Syllabus	The content of the subject consists of three parts as follows: Part 1: Advanced mathematics **Discrete Transforms** (discrete cosine transform, modified discrete cosine transform, discrete sine transform, discrete wavelet transform, discrete-time transform, data-dependent transform, distance transform, fractal transform, Hough transform, perspective transform); mathematical modeling, statistical analysis, optimization, fuzzy sets, transformation geometry, topology, graph, Markov random field, game theory and information theory Part 2: Advanced algorithms for visual computing **Computer graphics** (modeling non-rigid objects, visualizing multivariate data, surface/light interactions, computational geometry, texture mapping, fractals and chaos, morphing, interactions in virtual reality, animation design and structure, surface/light interaction, shadows, flow/volume visualization; radiosity, ray tracing). **Image processing, analysis and understanding** (multiple feature extraction, representation and fusion, image segmentation, thresholding, matching, classification, content-based image retrieval, compression, watermarking) **Computer vision** (stereo vision, optical flow, shape from X, motion, object recognition and tracking, image registration, multi-view 3D reconstruction, scene understanding) **Learning methods in vision** (classifier learning, support vector machines, discriminant analysis and Bayesian image analysis)

<table>
<tr><td></td><td>Part 3: The challenging research topics & wide applications
- Computational bioimaging
- 3D mapping, modeling and surface reconstruction
- Visual computing in digital media
- Graphical model and inference for visual computing
- Sparse methods for computer vision, graphics and imaging
- Visual computing with multimodal data structure
- Visual computing in Geoscience and remote sensing</td></tr>
<tr><td>Teaching/Learning Methodology</td><td>Lectures/Seminars/ Group discussions</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="6">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></td><td></td></tr>
<tr><td>1. Assignments</td><td>40</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>2. Project & Test</td><td>60</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Total</td><td>100</td><td colspan="6"></td></tr>
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Assignment(s): assessment of the theoretic studies with respect to the understanding of the relevant subject matters including new concepts, algorithms and techniques by proving answers to the assignment questions
Project: assessment of the ability for problem solving through real case studies and implementation of a prototype system for demonstration
Test: assessment of the overall performance by written report, oral presentation and exam or quiz.
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<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>Lecture/Tutorial/Lab</td><td>39 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>Self-study</td><td>83 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>122 Hrs.</td></tr>
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<tr><td>Reading List and References</td><td>

1. Ramsay, J. O. and Silverman, B.W. (2005) Functional data analysis, 2nd ed., New York : Springer, ISBN 0-387-40080-X
2. Frank Nielsen (2005): Visual Computing – Geometry, Graphics & Vision, Charles River Media Graphics
3. Angel (2004): Interactive Computer Graphics: A Top-Down Approach Using OpenGL, 4th Ed., Addison Wesley
4. Steger, Carsten, Markus Ulrich, and Christian Wiedemann (2008). Machine Vision Algorithms and Applications. Weinheim: Wiley-VCH. ISBN 978-3-527-40734-7
5. Milan Sonka, Vaclav Hlavac and Roger Boyle (2008). Image Processing, Analysis, and Machine Vision. Thomson. ISBN 0-495-08252-X.
6. E. Roy Davies (2005). Machine Vision: Theory, Algorithms, Practicalities. Morgan Kaufmann. ISBN 0-12-206093-8.

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