IMPERIAL

Module Specification

Basic details

UID		Cohorts covered	Earliest cohort: 2023; Latest c: 2026
Long title	Computational Sensing and Imaging		
New code	ELEC70085	New short title	

Brief description of module *(approx. 600 chars.)*

As conventional hardware and algorithms are being driven to their limits, researchers have started to realize the benefits of a co-design approach that leverages on a symbiotic relationship between hardware and algorithms. Instead of traditional "capture first, process later" approach, the hardware-software co-design approach surpasses traditional bottlenecks in sensing. At the convergence of inverse problems, physical models and optics/vision, the module will focus on the foundational principles of this emerging topic. Theoretical approaches will focus on abstracting inverse problems from wider, inter-disciplinary applications and provide for mathematical tools for solving such problems. Practical/applied experience will entail application of algorithms on experimental data acquired from novel sensors.

815 characters

Available as a standalone module/ short course? N

Statutory details

	ECTS	CATS	Non-credit	HECOS codes
Credit value	5	10	N	
FHEQ level	Level 7			

Allocation of study hours

	Hours	
Lectures	20	
Group teaching	10	*Incl. seminars, tutorials, problem classes.*
Lab/ practical	0	
Other scheduled	0	*Incl. project supervision, fieldwork, external visits.*
Independent study	95	*Incl. wider reading/ practice, follow-up work, completion of assessments*
Placement	0	*Incl. work-based learning and study that occurs overseas.*
Total hours	125	
ECTS ratio	25.00	

Project/placement activity

Is placement activity allowed? No

Module delivery

Delivery mode	Taught/ Campus	Other	
Delivery term	Term 1	Other	

Ownership

Primary department	Department of Electrical and Electronic Engineering
Additional teaching	N/A

departments	
Delivery campus	South Kensington

Collaborative delivery

Collaborative delivery?	N
External institution	N/A
External department	N/A
External campus	N/A

Associated staff

Role	CID	Given name	Surname
Module Leader		Ayush	Bhandari

Learning and teaching

Module description

Learning outcomes	By the end of this module, you will be able to: - model the data acquisition process by using advanced mathematical tools - develop algorithms for inverse problems. - design alternative sensors by leveraging tools from different domains. - analytically, numerically and experimentally analyse data from novel sensor.
Module content	Introduction to Computational Sensing Sensing and Imaging Toolkit: a) 1D Sampling | 2D Imaging | 3D Voxel Acquisition b) Optics, Image Sensors and Image Formation Computational Toolkit: a) Modeling: Forward vs Inverse Problems b) Sampling Architectures c) Math Tools (Signal Proc., Linear Algebra and Optimization). d) Algorithmic Toolkit (e.g. Spectral Estimation, Orthogonal Matching Pursuit, Super-resolution, One-Bit Noise Shaping, Sparse Recovery etc.) Plenoptic Coding: a) Spatially Coded Imaging b) Temporally Coded Imaging c) Light-field Imaging d) Multispectral Imaging Case Studies a) Single-Pixel Imaging b) Time-of-Flight Imaging c) Fluorescence Lifetime Imaging d) Modulo Sensing and Imaging
Learning and Teaching Approach	The module will be delivered primarily through large-class lectures introducing the key concepts and methods, supported by a variety of delivery methods combining the traditional and the technological. The content is presented via a combination of slides, whiteboard and visualizer. Lecture notes willl also be provided. Learning will be reinforced through lab sessions and guest lectures from world-leading experts.

Assessment Strategy	This module presents opportunities for both formative and summative assessment. You will be formatively assessed through practical sessions. You will have additional opportunities to self-assess your learning via (ungraded) problem sheets. You will be summatively assessed by a written closed-book examination at the end of the module. The exam is specifically formulated to assess design-based learning outcomes in
Feedback	You will receive feedback on examinations in the form of an examination feedback report on the performance of the entire cohort. You will receive individual feedback on the coursework in the form of a written report You will receive feedback on your performance whilst undertaking practical exercises, during which you will also receive instruction on the correct solution to the problems. Further individual feedback will be available to you on request.
Reading list	Book: Computational Imaging, MIT Press (2022) https://mitpress.mit.edu/books/computational-imaging

Quality assurance

Date of first approval	February 2022
Date of last revision	July 2026
Date of this approval	
Module leader	Ayush Bhandari

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QA Lead	
Department staff	
Date of collection	
Date exported	
Date imported	

Notes/ comments	

Template version #####

Assessment details

Grading method	Numeric	Pass mark	50%

Assessments

Assessment type	Assessment description	Weighting	Pass mark	Must pass?
Examination	Close-book written examination	100%	100%	N
		100%		