Data-Centric Engineering

Welcome and Introduction

qmul.ac.uk/dce

• Introduction to Data-Centric Engineering
• Our Aims
• A Unique Centre for Doctoral Training
• Queen Mary University of London
• Research Opportunities
• A Bespoke Training Programme
• Professional Doctorates
• Our Industry Partners

Dr Eram Rizvi
Deputy Dean for Research
5:15 – 5:30: Welcome and Introduction
5:30 – 6:00: Why do an EngD in Data-Centric Engineering?
6:00 – 6:30: Avoiding Imposter Syndrome - recognising your research and innovation skills
6:30 – 6:45: Q&A session
6:45 – 7:00: Meet our team
Welcome and Introductions

Dr Eram Rizvi  
CDT Director

Dr Jun Chen  
Director of Training

Prof Mark Sandler  
Director of Partnerships

Dr Gabriella Caminotto  
Centre Manager

Prof Nick Bryan-Kinns  
Director of Recruitment

Ms Zi Parker  
Doctoral College Manager
Data-Centric Engineering

Data science: uses scientific methods, processes, algorithms and systems to extract knowledge from structured and unstructured data.

Data science techniques include data mining, machine learning and interrogating big data.

Engineering: uses scientific principles to design and build machines, structures, and systems e.g. bridges, vehicles, biomolecules, new materials...

Broad range of specialisms:
- Chemical Engineering
- Materials Research
- Electronic Engineering
- Computer Science

Each spans theoretical approaches to applied science

- Data-Centric Engineering is a new emergent field
- Sits at the interface of data science and engineering,
- Combines mathematical modelling with the latest advances in Big Data and Artificial Intelligence
Our Aims

• Expand doctoral research skills in the UK
  Address skills gap - many research jobs unfilled after 1 month
  Address the Government’s industrial strategy - published 2018

• Remove individual’s barriers to doctoral training
  Studies indicate the top 3 reasons for not taking a PhD are vocational relevance, financial barriers, and issues of self-confidence

  • Diversify talent in research active roles - make research inclusive
  • Build porous integrated communities between industry and academia

  • Increase industry investment in research

  • UK to achieve target of 2.4% GDP investment in research
    Roughly split ⅓ industry and ⅔ government research funding

We will build a world-class cohort of high-tech entrepreneurs and technology leaders
Our Centre for Doctoral Training in Data-Centric Engineering is unique

**Engineering Doctorate (EngD) 4-year research programme**

- **Professional Doctoral Scholars (PDS)**
  - Out of academia for 3+ years
  - Remain in full-time employment
  - Salary paid in full by employer
  - Employer engages in research
  - Tuition fees paid by QMUL

- **Enterprise Doctoral Scholars (EDS)**
  - Out of academia for 3+ years
  - Enter into full-time study
  - Tax-free stipend of £20,500
  - Tuition fees paid by QMUL
  - Research periods in industry

**QMUL**
- Induction re-orientation into academia
- Fully integrated training
- Fully supervised by QMUL academics
- Additional research mentoring
QMUL has its roots in 4 historic London Colleges:

- St Bartholomew’s Hospital (founded 1123)
- The London Hospital (founded 1740)
- Westfield College (founded 1882)
- Queen Mary College (founded 1887)

Founded as part of Victorian drive to improve the social and educational conditions of the people of the East End.

<table>
<thead>
<tr>
<th>Rank</th>
<th>University</th>
<th>% 3*/4* outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Imperial</td>
<td>86.59</td>
</tr>
<tr>
<td>2</td>
<td>LSE</td>
<td>83.68</td>
</tr>
<tr>
<td>3</td>
<td>Warwick</td>
<td>83.66</td>
</tr>
<tr>
<td>4</td>
<td>Cambridge</td>
<td>83.31</td>
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<tr>
<td>5</td>
<td>QMUL</td>
<td>83.15</td>
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<tr>
<td>6</td>
<td>Cardiff</td>
<td>83.10</td>
</tr>
<tr>
<td>7</td>
<td>Oxford</td>
<td>83.01</td>
</tr>
<tr>
<td>8</td>
<td>Bath</td>
<td>81.95</td>
</tr>
<tr>
<td>9</td>
<td>Sheffield</td>
<td>80.22</td>
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<tr>
<td>10</td>
<td>Southampton</td>
<td>80.14</td>
</tr>
<tr>
<td>11</td>
<td>King’s</td>
<td>79.99</td>
</tr>
</tbody>
</table>

Strong continuing ethos of social inclusion
- 91% students from state school;
- 60% students are black / minority ethnic;
- 42% students first in family to go to university
- 27% students from low income households (<£10k)

This diversity is our strength
- 9 Nobel Prize Winners
- Member of Russell Group top research-intensive university
- Ranked 5th in UK for quality of research publications†
- Ranked 110th university in world ranking✻
- London’s 3rd largest university

†Latest Research Excellence Framework
✻Times Higher Ed. University Rankings
Queen Mary University of London (QMUL)

London’s campus university
Charterhouse Square,
West Smithfield
Lincoln’s Inn Fields

Whitechapel
Campus

Mile End Campus

27,000 students;
2,000 PhD students;
4,600 staff
Faculty of Science & Engineering (S&E)
- School of Mathematical Sciences (SMS)
- School of Physics and Astronomy (SPA)
- School of Engineering & Materials Science (SEMS)
- School of Electronic Engineering & Computer Science (EECS)
- School of Biological and Chemical Sciences (SBCS)

Faculty of Humanities and Social Sciences (HSS)
- School of Medicine & Dentistry (SMD)

Cross-faculty institutes
- Inst. of Bioengineering (IoB)
- Inst. of Applied Data Science (IADS)
- Life Sciences Inst. (LSI)
- Materials Research Inst. (MRI)
- Digital Environment Research Inst. (DERI)

Faculty of Science and Engineering
- 5 Schools
- 4 inter/multi-disciplinary institutes
- 300 academic research staff
- 800 PhD students
- £42m research income in 2019/20

- Recognised for our distinctive, curiosity-driven and applied research
- Research supported by world-class research infrastructure
- Entrepreneurship and innovation embedded in our research culture
Major Interdisciplinary Research Themes
Research in Digital Creative Industries
Materials Science and Condensed Matter Physics
Data Science
Control and Systems Engineering
Robotics

• Please explore the projects on offer through the School webpages linked below
• Feel free to contact any of our academics
• More advice on research proposals given in Workshop 2 - Wednesday 7th October
• Register here

Links to Available Doctoral Research Projects in our Schools
• School of Electronic Engineering and Computer Science
• School of Engineering and Materials Science
• School of Chemical and Biological Sciences
• School of Physics and Astronomy
• School of Mathematical Sciences
Examples of Doctoral Research Projects on offer - please email supervisors for more information

<table>
<thead>
<tr>
<th>Supervisor</th>
<th>School</th>
<th>Project Title</th>
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</thead>
<tbody>
<tr>
<td>Dr. Chris Jones</td>
<td>Biological &amp; Chemical Sciences</td>
<td>Developing of Novel Cannabinoids with Machine Learning</td>
</tr>
<tr>
<td>Prof. Christian Beck</td>
<td>Mathematics</td>
<td>Data-driven analysis and modelling of power-grid frequency dynamics</td>
</tr>
<tr>
<td>Dr Akram Alomainy</td>
<td>Electronic Engineering</td>
<td>Development of Novel Data-Centric Techniques in emergent wireless technologies (IoT / 5G / 6G)</td>
</tr>
<tr>
<td>Dr Richard Clegg</td>
<td>Electronic Engineering</td>
<td>Data-centric engineering for prediction and analysis of software controlled radio access networks</td>
</tr>
<tr>
<td>Prof. Adrian Bevan</td>
<td>Physics</td>
<td>Development of organic semiconductor radiation detectors</td>
</tr>
<tr>
<td>Prof. David Dunstan</td>
<td>Physics</td>
<td>Application of the Bayes Factor in Maximum Likelihood Fits in Data-Centric Disciplines</td>
</tr>
<tr>
<td>Dr Lin Wang</td>
<td>Computer Science</td>
<td>Deep Audio Inpainting for Digital Restoration and Music Enhancement</td>
</tr>
<tr>
<td>Prof. Josh Reiss</td>
<td>Computer Science</td>
<td>Parametric Controls from Data Analytics</td>
</tr>
<tr>
<td>Dr Seth Zenz</td>
<td>Physics</td>
<td>Designing novel ultra-thin low mass curved silicon imagining sensors for X-ray diffraction and nuclear security</td>
</tr>
<tr>
<td>Dr Yannick Wurm</td>
<td>Biological &amp; Chemical Sciences</td>
<td>A toolkit for pragmatic interrogation exploration &amp; hypothesis testing of disconnected genomic data</td>
</tr>
<tr>
<td>Dr Anthony Phillips</td>
<td>Physics</td>
<td>Using machine-learning techniques to identify new perovskite materials with electrical properties that exceeding those of inorganic perovskites</td>
</tr>
<tr>
<td>Dr Jens-Dominik Mueller</td>
<td>Engineering</td>
<td>Adaptive multi-fidelity robust design optimisation driven by machine learning</td>
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https://www.qmul.ac.uk/dce/research/
A Bespoke Training Programme

Doctoral Training and Research

QMUL has a **recognised leadership** in Doctoral Training and Research. We participate in multiple Doctoral Training Partnerships (DTPs) and Centres for Doctoral Training (CDTs)

- NERC Doctoral Training Partnership
  - UCL, KCL, Kew Gardens, and the Natural History Museum

- BBSRC Doctoral Training Partnership (with UCL, KCL)

- STFC Doctoral Training Partnership in Particle Physics and Astronomy

- 7 Centres for Doctoral Training
  - **Data-Centric Engineering**
  - Media Arts Technology
  - AI in Music
  - Intelligent Games
  - Data Intensive Science in Fundamental Physics
  - Plastic Electronics
A Bespoke Training Programme

The programme has four main pillars:
- Advanced taught courses: a bespoke programme of 6 taught courses in years 1-3
- Researcher development training of the cohort throughout years 1-4
- Industry placement throughout years 1-4
- Research projects throughout years 1-4

Three core research courses:
- Statistical Thinking and Engineering Mathematics
- Research Methods and Responsible Innovation
- Machine Learning

Electives include over 30 relevant data intensive science and engineering courses

Training benefits include:
- Access to all professional development / transferrable skills career training
- Bespoke support from dedicated academic mentor
- Access to all research facilities including high performance computing as appropriate
- Funding to attend international research conferences
- Financial assistance for child-care or carers during residential activities away from home

Eram Rizvi
# A Bespoke Training Programme

## Cores

<table>
<thead>
<tr>
<th>Research Methods &amp; Responsible Innovation</th>
<th>Statistical Thinking &amp; Methods</th>
<th>Machine Learning</th>
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<tbody>
<tr>
<td>Programming (Python) for Data Science</td>
<td>Data Mining &amp; Visualisation</td>
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<tr>
<td>Numerical Optimisation in Engineering Design</td>
<td>Introduction to Robotics</td>
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## Samples of Electives

<table>
<thead>
<tr>
<th>Elective(s)</th>
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<th>Elective(s)</th>
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<tbody>
<tr>
<td>Mathematics for Engineering Students</td>
<td>Electronics</td>
<td>Design for Human Interaction</td>
<td>Engineering Instrumentation</td>
<td>Embedded Systems</td>
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<tr>
<td>Digital Audio Effects</td>
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## Programme Structure

<table>
<thead>
<tr>
<th>Year 1</th>
<th>2 Cores/1 Elective</th>
<th>Research Projects</th>
<th>Other Activities*</th>
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<tr>
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<tr>
<td>Year 2</td>
<td>Elective(s)</td>
<td>Industrial Placements**, Research Projects</td>
<td></td>
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<tr>
<td>Year 3</td>
<td>Elective(s)</td>
<td>Industrial Placements**, Research Projects</td>
<td></td>
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<tr>
<td>Year 4</td>
<td></td>
<td>Industrial Placements**, Write-up</td>
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* Re-orientation to Academic Study, Personal Training Plans (PTPs), PhD Cohort Days (Networking/Impact & Making the most of your conference/research), Recognising Imposter Syndrome, Employability programme**, EPSRC Student Conference Day (off site), Writing for Researchers, Turing Masterclasses

** Only for Enterprise Doctoral-Scholars (EDSs)

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** Taught Component ** Industry Engagement ** Research Component ** Transferrable Skills
Professional Doctorates are recognised “level 8” qualifications
Only Universities have power to award these degrees

**Like a PhD**, these doctorates are research-based qualifications

- Taught elements form part of the training
- Supervised by a QMUL academic
- Majority is research and a contribution to creating new knowledge
- A final dissertation is required and assessed by two expert examiners
- The final oral examination (or ‘viva’) is conducted by the two examiners
- Gains you a title of “Dr”

The EngD is QMUL’s first professional doctorate in Science and Engineering
First Doctoral programme spanning the full faculty

**Unlike a PhD** the EngD

Requires substantial industrial application
Research is applied and / or work-place based
May comprise a portfolio of research topics - up to 4 in related areas
We are working with a growing number of industry partners offering
- collaborative research projects
- industry training
- applications for our PDS route