

Education

PhD Physics, University of Cambridge (2019-2023).

Thesis: *Machine learning approach to model the microstructure and strength of nickel superalloys*.
Awarded September 2023.

- Demonstrated that by incorporating domain knowledge from physics and chemistry, the transferability of Gaussian process regression models can be greatly improved.
- Showed that by including physics-based representations of heat treatments, said models have a clear advantage over conventional equilibrium thermodynamic modelling.
- Fitted models to a database that I compiled myself using open-source data.

PhD funded by an EPSRC ICASE award for the 1+3 year Computational Methods for Materials Science CDT programme. The ICASE industrial partner was Dassaults Systèmes UK.

MPhil Scientific Computing (CDT), University of Cambridge (2019).

Thesis: *A data driven approach to using MD and DFT simulations in the design of improved alloys for aerospace and additive manufacturing applications*. Taught courses taken: density functional theory, atomistic simulation, mesoscale simulation.

MMathPhys Theoretical Physics (1st class), University of Oxford (2018).

Undergraduate integrated masters. Masters-level courses taken include: Quantum Condensed Matter Physics I, II & III, Numerical Linear Algebra, Networks, Renormalisation Group.

Publications

- PL. Taylor, G. Conduit, *Machine learning superalloy microchemistry and creep strength from physical descriptors*, Comp. Mat. Sci., 227 (2023) [doi.org/10.1016/j.commatsci.2023.112265 | <https://arxiv.org/abs/2212.06755>]
- PL. Taylor, G. Conduit, *Machine learning predictions of superalloy microstructure*, Comp. Mat. Sci., 201 (2022) [doi.org/10.1016/j.commatsci.2021.110916 | arxiv.org/abs/2109.13762]
- SJ Singh et al, *Ultrahigh critical current densities, the vortex phase diagram, and the effect of granularity of the stoichiometric high- T_c superconductor $\text{CaKFe}_4\text{As}_4$* , Phys. Rev. Mat. 2 074802 (2018) [doi.org/10.1103/PhysRevMaterials.2.074802]

Selected Talks

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| July 2022 | <i>Using domain knowledge in machine learning models of alloy properties</i> , Lennard-Jones Centre Student Day (Department of Engineering, Cambridge). |
| April 2022 | <i>Gaussian process regression modelling of superalloy microstructure</i> , TMS Artificial Intelligence in Materials Conference 2022 (Pittsburgh, PA). |

- March 2022 *Computational metallurgy: applying humanity's newest science to its oldest*,
Clareity Symposium (Clare College, Cambridge).
- November 2019 *The modern day blacksmith*, Dassault Systèmes EuroNorth Annual Meeting
(Dassault Systèmes UK, Cambridge).
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Experience

Postdoctoral research:

- Research Associate at Imperial College London (2023—current). Developing deep learning algorithms to detect defect formation in laser powder bed fusion additive manufacturing. The role involves close collaboration with experimental colleagues and industrial collaborators. In Paul Hooper's group in the Department of Mechanical Engineering.

Teaching & outreach:

- Co-supervising (2023—2024) a final-year undergraduate research project at Imperial.
- Taught 3rd year physics students at Cambridge University (part II Thermal and Statistical physics, 2019—2022). This involved marking problem sets and teaching in 1-on-3 supervision groups.
- Demonstrated for 3rd year physics practical computing courses at Cambridge University (2021).
- Have delivered a number of 1-hour outreach talks for secondary and sixth form students.
- Developed an outreach website for the theoretical physics group at the University of Oxford (paid internship, summer 2018). This included both web and content development.

Other research:

- Have taken part in a number of hackathons, including the Citadel Data Open finals.
- Worked alongside my PhD industrial sponsors at Dassault Systèmes, including giving a monthly presentation on my project progress to the BIOVIA group.
- Carried out an undergraduate research project modelling the response of superconductors to high magnetic fields in the group of Dr. Amalia Coldea at Oxford University (paid internship, summer 2017).
- Did an R&D internship at a biomedical engineering firm, Quanta Fluid Solutions (summer 2015).

Additional experience:

- Was Creative Director and then subsequently Editor-in-Chief of the student science magazine at Oxford University (2017-18 academic year).
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Skills

Technical skills:

- Expertise in python including ML and data science libraries: pytorch & gpytorch, scikit-learn, scikit-image, pandas, numba. Have also obtained a certificate of competency in CUDA fundamentals.

- JavaScript and C++ experience, as well as Linux and git (github.com/PatLT).
- Atomistic simulations: molecular dynamics (LAMMPS) and density functional theory (CASTEP) software, as well as Materials Studio.
- Experience using high performance computing clusters.

Research skills:

- First name author on two publications; both of which were largely planned-out and written by myself. Proficient at typesetting in Latex.
 - Frequently put-together and deliver talks—spanning different lengths, audience sizes, and technical levels.
 - Technical presentations given at international conferences, university seminars, and monthly meetings with my PhD industrial sponsor (Dassault Systèmes).
 - Non-technical talks given at Dassault Systèmes EuroNorth Quarterly Meeting, Clare College Student Symposium, and outreach events for school groups.
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