

RESEARCH INTERESTS

I am a research associate in computational chemistry with a specific interest in the sequence and structural properties of proteins. Currently, my research is focused on understanding undesirable antibody solution behaviour in biopharmaceuticals. To understand this problem, I use a combination of theoretical and computational approaches such as structural/sequence bioinformatics, continuum electrostatic, data mining and machine learning. I am also the developer of the protein-sol web server to make our in-house modelling and theoretic software publicly, and freely, available.

EDUCATION

- 2013 - 2017** **PhD Chemical Engineering**, University of Manchester, BBSRC DTP scholarship
Thesis title: *Computational Modelling Approaches for Studying Protein-Protein and Protein-Solvent Interactions in Biopharmaceuticals*. Under the supervision of Robin Curtis, I studied the factors limiting the development of next generation biological drugs by investigating the solution properties of high concentration antibodies in different solution conditions. Combined computational and biophysical characterisation techniques, for example, static and dynamic light scattering, small angle X-ray scattering, electrostatic calculations and bioinformatics.
- 2009 - 2013** **MbiolSci Biochemistry 1st Class (Hons)**, University of Sheffield
I was awarded a First class degree and ranked 8th within the department, and also awarded a scholarship for academic achievement. My Master's year was spent in industry at AstraZeneca. During my undergraduate, I specialised in chemistry, biophysical characterisation, structural and mechanistic biology modules.

RESEARCH EXPERIENCE

- 2017 - CURRENT** **PDRA Computational and Theoretical Chemistry**, University of Manchester
As part of the Jim Warwicker group, I am responsible for developing machine learning models and bioinformatics software for studying protein solubility and behaviour in solution with the aim of informing liquid formulation design for novel biopharmaceuticals. I have developed regression and classification algorithms in R and python, as well as general bioinformatics algorithms and have experience in FORTRAN and perl. Much of this research and in-house software has been made freely available online as a web application I developed available at <https://protein-sol.manchester.ac.uk>.
- 2015 TO 2016** **Visiting Doctoral Researcher in Theoretical Chemistry**, Lund University
On secondment with Mikael Lund, I parameterised activity coefficients of a number of monovalent salts to help develop an improved understanding of the molecular origin of specific ion effects. These calculation were conducted using Metropolis Monte Carlo simulations developed in C++ and python.
- 2014** **Early Warnings System Intern Officer**, National Health Service, Manchester
As part of my PhD, I conducted a internship (PIPs) at the NHS in their Early Warnings System group. I merged various datasets to build a model that identified factors correlating with hospital mortality and serious incidents. I wrote my findings up as a white paper on mental health, with the findings presented at a national conference. Strengthened data acquisition techniques, and communication skills to explain detailed statistical and data analyses for a non-technical audience.
- 2012 - 2013** **Master's year Industrial placement**, AstraZeneca, Alderly Edge
Responsible for developing a new diagnostic reagent to support drug development. Co-authored a review paper on antibody affinity tools that made the front cover of the Journal of Biomolecular Screening. Worked collaboratively with international teams of different specialities. Developed skills in a wide variety of molecular biology techniques from phage display to cloning and validation.
- SUMMER 2012** **Wellcome Trust Biomedical Science Vacation Scholar**, Royal Hallamshire Hospital
Awarded a Wellcome Trust Biomedical Science Vacation Scholarship to study the role of long non-coding RNAs in bladder cancer development. This research produced large data sets requiring a detailed investigation to deduce the complex relationships between genes and their products. Became familiar with cell culture, RNA microarrays, DNA methylation and handling genome datasets.
- 2011 - 2012** **Third year research project**, University of Sheffield
Third-year undergraduate research project with Mike Williamson studying the stabilising effect of salt bridges in barnase. This work resulted in a paper on detecting salt bridges using 2D NMR.
- SUMMER 2011** **Lab Technician**, BioServ UK
Worked for a biotech company specialising in the production and validation of antibodies and developed a number of antibodies for industrial clients. Developed skills in the entire antibody production process from hybridomas to protein purification and protein assay.

PUBLICATIONS

- 2019** **Hebditch M**, Warwicker J.
Charge and hydrophobicity are key features in sequence-trained machine learning models for predicting the biophysical properties of clinical-stage antibodies
BioRxiv
- 2019** **Hebditch M**, Warwicker J.
Investigation of protein surface polarity and pH-dependent properties using a new web tool: application to antibodies shows that antibody-antigen interfaces tend to be relatively polar.
Scientific Reports
- 2018** **Hebditch M**, Roche A, Curtis R, Warwicker J.
Models for antibody behaviour in hydrophobic interaction chromatography, and in self-association.
Journal of Pharmaceutical Sciences (Featured Article)
- Sønderby P, Bukrinski JT, **Hebditch M**, Peters GHJ, Curtis R, Harris P.
Self-Interaction of Human Serum Albumin: A Formulation Perspective.
ACS Omega
- 2017** **Hebditch M**, Curtis R, Warwicker J.
Sequence composition predicts immunoglobulin superfamily members that could share the intrinsically disordered properties of antibody CH1 domains
Scientific Reports
- Hebditch M**, Carballo-Amador M.A., Charonis S, Curtis R, Warwicker J.
Protein-Sol: A web tool for predicting protein solubility from sequence.
Bioinformatics
- Corbett D, **Hebditch M**, Keeling R, ..., Sarangapani P, Pathak J, Van Der Walle C, Baldock C, Avendaño C, Curtis R.
Coarse-Grained Modeling of Antibodies from Small-Angle Scattering Profiles
Journal Of Physical Chemistry B
- 2014** Marsden C, Eckersley S, **Hebditch M**, Kvist A, Milner R, Mitchell D, Warwicker J, Marley A.
The Use of Antibodies in Small-Molecule Drug Discovery.
Journal of biomolecular screening
- 2013** Williamson M, Hounslow A, Ford J, Fowler K, **Hebditch M**, Hansen P.
Detection of salt bridges to lysines in solution in barnase.
Chemical Communications

AWARDS AND GRANTS

- 2018** Early Career Research Award Co-investigator (£2000) for a proof of concept study for the development of an effective lactate kinase for the production of coenzyme F420, Manchester Institute of Biotechnology.
- 2016** Innovation Optimiser (£5625) for Metriculate. Invited to join AccelerateME startup accelerator.
- 2015** Venture Further (£2500), IQuBIT Digital Award (£2000), and Sheffield first steps fund (£250) for Metriculate startup.
- 2012** Wellcome Trust Scholarship, Sheffield Undergraduate Research Experience scheme.
- 2009** Three year alumni schoolship for academic achievement, University of Sheffield.

PROGRAMMING SKILLS

- BIOINFORMATICS** Machine learning, regressions, classifications, data mining, sequence and structural calculations, electrostatics, sequence alignments, databases, jupyter, numpy/scipy, pandas, ggplot, matplotlib, caret.
- LANGUAGES** R, Python, Perl, shell/bash, PHP, javascript.
- LINUX** Debian, Ubuntu, Red Hat, clusters, system administration, package management, version control.
- WEB** HTML/CSS, javascript, d3.js, Apache web server, security, firewalls, front and backend, web design.

TEACHING AND OTHER EXPERIENCE

- 2015 - CURRENT** **Co-founder**, Metriculate LTD.
Director and Co-founder of a digital/web start-up. Demonstrated networking and oral/written communication skills to successfully compete for over £10,000 in funding. Collaborated with academia, business and start-ups.
- 2015 TO 2016** **University of Manchester Intellectual Property Fellow**, UMIP
Analysed new intellectual property developments at the University of Manchester, and assessed the potential for commercialisation. Required critical assessment of new technologies, conducting literature / patent searches for prior art and communicating the value of the invention.
- 2014 TO 2016** **Graduate Teaching Assistant**, University of Manchester
Demonstrator for lab practicals and produced an e-learning module for students to learn programming.
- 2014 - 2015** **Academic Mentor**, Manchester Access Programme
Tutored 13 students as part of a flagship widening participation scheme run by the University of Manchester.

CONFERENCES AND WORKSHOPS

- JAN 2019** Flash talk and best poster prize at 4th N8 Biophysical and Biochemical Symposium, University of Sheffield.
- JUN 2018** Chaired Theoretical and computational chemistry panel at University of Manchester PhD chemistry conference.
- OCT 2016** Talk at Advances in Biophysical Methods for Protein Characterisation Conference, Palermo.
- SEP 2015** Attended BioProNet Early Career Researcher Development workshop, Nottingham.
- AUG 2012** Awarded best talk at SURE Conference, University of Sheffield.