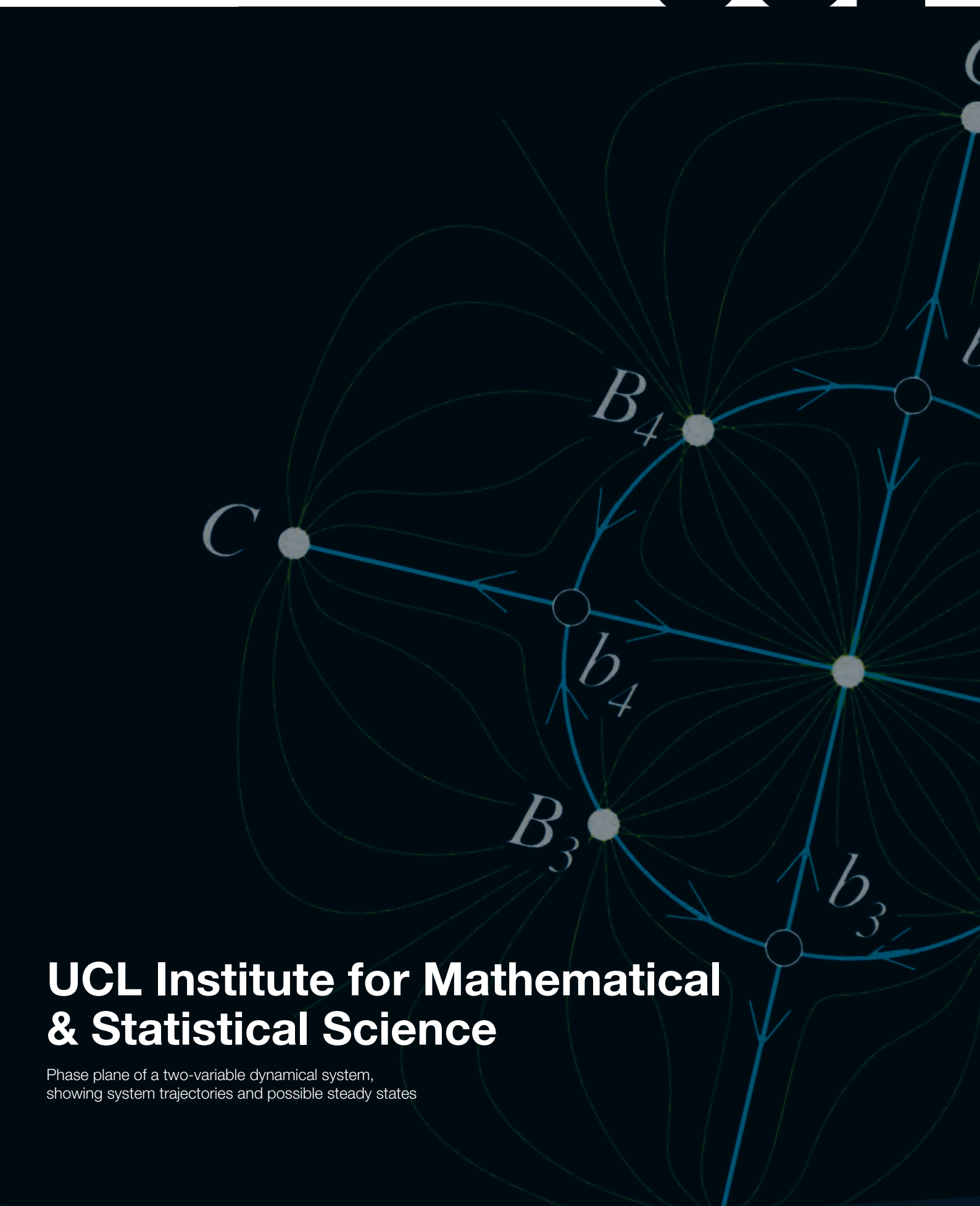
UCL FACULTY OF MATHEMATICAL
& PHYSICAL SCIENCES

UCL



UCL Institute for Mathematical & Statistical Science

Phase plane of a two-variable dynamical system,
showing system trajectories and possible steady states

UCL Institute for Mathematical and Statistical Sciences - IMSS

© UCL Health Creatives

Our Vision

This century's advances will be built on mathematical foundations. Significant new applications of the mathematical sciences are being forged in many areas including biology, medicine, economics, engineering, environment, social sciences, technology, transport and security. UCL has ambitions to be at the forefront of this endeavour, providing a central focus for mathematical science activity in a facility tailored to modern research and education in this fundamental discipline.

The IMSS will be greater than the sum of its parts, co-locating and expanding the departments of Mathematics and Statistical Science to bring UCL into the top 20 institutions globally for mathematical sciences. It aims to be London's leading centre for research, teaching and collaboration in mathematics and statistics, establishing UCL as a global leader and outward looking centre for the mathematical sciences and its applications. Exciting new appointments, from early career to established world-leading researchers, along with interdisciplinary appointments connecting with the wider UCL community, will lead to a concentration of around 135 academic and teaching staff and will support a thriving community of students to acquire the quantitative skills that are increasingly in demand in our global society. The IMSS will create an atmosphere of lively research collaboration not only between mathematical scientists themselves, but also with departments across UCL's unique multi-disciplinary strengths. This will lead to fundamental breakthroughs across disciplines, while providing the Mathematics and Statistics graduates that society needs.

Beyond UCL, the IMSS will fully exploit its central London location by strengthening interactions with institutions such as the Alan Turing Institute,the Francis Crick Institute, GCHQ, London's financial industry and government departments. London has easy transport connections to Europe and beyond: the IMSS will be internationally accessible, and will have facilities enabling a vibrant visitor and events programme that will put UCL on the map as a major world centre for the mathematical sciences. The IMSS will also provide a focus for outreach and engagement activities capturing the public's interest and imagination, and stimulating the uptake of mathematical sciences by school leavers, in particular from groups that are currently under-represented in the profession. An investment in the vision of IMSS is an investment in our mathematical future.

Mathematical Science Matters

The mathematical sciences, interpreted in the broadest sense (including pure and applied mathematics, statistics and operations research) form the foundation of the scientific data and engineering disciplines, and increasingly, the biological, and medical sciences. Medical imaging, climate modelling, financial risk analysis and internet searching are just a few examples of how mathematical sciences benefits us. More recently, the 'Big Data Revolution' has uncovered a host of new challenges for mathematicians and statisticians. Mathematical science is finding applications and use in unexpected areas of the humanities and social sciences, such as UCL's analysis and modelling of the 2011 London riots. The further development and application of the mathematical sciences will play a major role in addressing many of society's foremost challenges throughout the 21st century.

A population educated to a high level in mathematics and statistics is crucial to the UK economy. According to the 2012 Deloitte report, *Measuring the Economic Benefits of Mathematical Science Research in the UK*, mathematical sciences research contributes 10% of all jobs in the UK, in sectors including finance, defence, life sciences and medicine, national security and manufacturing.

Despite this, there is a skills shortage both in the UK and globally. A recent report from the US National Academy of Sciences concluded that there is a need to produce graduates who are knowledgeable across a broad range of disciplines, communicate well with researchers in other areas and understand the role of mathematical science in other fields and the economy.

By focusing UCL's considerable strengths in mathematical and statistical science research and education, the IMSS will increase UCL's capacity to address this shortage and train highly skilled graduates in a global society hungry for mathematically talented graduates.

UCL Mathematics have produced analysis and modelling for the 2011 London riots.

Data visualisation before the digital age: wooden model of a data set representing the heights of fathers and their sons, used to illustrate the theory of linear regression

Mathematical Sciences at UCL

The mathematical sciences have always been part of UCL's proud radical culture and history. Mathematics was one of the small number of disciplines established by UCL's original benefactors in 1826. The Department of Statistical Science, founded in 1911, was the first statistics department to be established anywhere in the world.

The departments' research covers a broad range of activity including geometry, analysis, fluid mechanics, financial mathematics, data science, stochastic modelling and time series, number theory, computational mathematics and statistics, and biostatistics. We are known for crossing traditional disciplinary boundaries and have productive collaborations with UCL departments and interdisciplinary centres in areas ranging from engineering to women's health, experimental biology to disaster reduction.

Beyond UCL and academia, the departments' research is used in a wide variety of organisations and application areas: national security, medicine and healthcare provision, and the aeronautical, food and sporting sectors are just some areas where UCL's mathematical sciences research has contributed directly to improved performance and associated economic benefits. Specific examples include the design of improved aircraft ice protection systems, allowing safer operation; tools such as risk calculators for heart surgery that are influencing clinical practice; increased understanding of issues related to noise propagation from infrastructure including roads and wind turbines, resulting in changes in thinking about freeway noise mitigation strategies; and methodology that is being used by energy companies to improve the operational management of power plants so as to reduce energy costs.

IMSS: the future

The UCL of the future will remain radical, and will continue to encourage disruptive thinking, increasingly breaking down traditional barriers of faculty and discipline. The mathematical sciences will play a key role in achieving this, with the IMSS bringing increased capacity to create exciting new links and establish new areas of high-impact application. Crucially, such cross-disciplinary interaction will also drive the further development of mathematical science itself.

We will recruit and nurture outstanding mathematicians and statisticians, and provide an environment in which they can flourish and contribute to wider society. The IMSS will reflect the cosmopolitan environment of London, with a dynamic and diverse community of academic and professional services staff.

We will host national and international meetings, conferences and workshops in the mathematical sciences, with involvement from learned societies in our disciplines. With a critical mass of research excellence, an exciting events programme and a prime and accessible location in the heart of London, the IMSS will be a top destination for mathematical scientists visiting the UK.

Mathematical science is a vast and evolving discipline: with more research staff interacting with other UCL departments and visiting scholars, the IMSS will enable us to cover most, if not all, of its research areas. Mathematical science research flourishes best when people are brought together, and is at its most exciting when establishing links, often unexpected and surprising, between different subfields of research. This is true of many of the most celebrated recent successes in mathematics, including Wiles' remarkable proof of Fermat's Last Theorem which involved ideas from both geometry and number theory, the interplay of which remains an active and fertile area of research to this day.

Dynamic hub spaces facilitate cross-pollination of ideas

Educating the next generation

The IMSS will put over 1,200 mathematical science undergraduates at the heart of its activity, enabling them to interact with world-leading researchers in an intellectually thrilling community, and providing a top quality university experience with modern high-quality teaching facilities. Students will take advanced courses connecting with exciting research developments, such as the rapid expansion of Data Science and Artificial Intelligence, both areas for which mathematics provides the fundamental language. Our graduates will receive a broad training in mathematics, statistics and their applications, with experience in programming and computation, and with opportunities to develop their communication skills. Equally, the IMSS research and teaching staff will inspire students from across UCL studying a variety of disciplines.

At postgraduate level, the IMSS will be home to 150 Master's students and over 200 doctoral students. Master's students will have their own study and social areas, while doctoral students, the lifeblood of any university mathematical science institute, will be fully integrated with academic staff, with access to shared social and common areas.

> "The moving power of mathematical invention is not reasoning but imagination".
>
> Augustus De Morgan, first Professor of Mathematics at UCL.

Mathematics students working together

London's Global University

The IMSS shares UCL's ambition to be London's Global University. The departments' students and staff already form an international community, with global activities in both research and teaching. London itself is an international city offering opportunities to mathematical scientists at all levels, from interaction with Whitehall, Westminster and London's world-class hospitals, through to community outreach. Our graduates are in demand, especially from financial industries based in London and other major cities across the world: we must continue to produce individuals with the required quantitative and problem-solving skills, who are able to work in teams and have excellent communication and computing skills.

Mathematical science expertise is highly valued by government and its agencies. UCL Mathematics and Statistical Science departments currently maintain many links with these bodies including the Department of Transport, the Environment Agency, the Financial Conduct Authority, the Food Standards Agency, GCHQ and others, with activities ranging from the tracking and characterisation of food-borne illnesses to the assessment of volcanic ash risk to aviation.

London is home to other world-class, higher education institutions with excellent mathematical science groups and we aim to further our already effective and productive links with them. The IMSS will also capitalise on London's unrivalled transport links to Europe and beyond, to make it the destination of choice for visiting mathematical scientists to the UK.

Researchers in Statistical Science are using Oyster card data to monitor journey times and station usage on the London Underground, for incident detection purposes. Background map: © OpenStreetMap contributors: openstreetmap.org.

Public Engagement and Outreach

Society's demand for trained mathematicians and statisticians has never been higher. To meet this demand, universities have a responsibility to encourage young people – particularly those from less traditional backgrounds – to enter the discipline. Through high-profile presenters like Hannah Fry, a UCL Mathematics alumna, the mathematical sciences and their applications are enjoying unprecedented popular appeal. The IMSS, with its prominence and large lecture theatres will provide an ideal venue for popular talks and practical sessions aimed at public engagement and schools. Building on this mathematical renaissance, the IMSS will help turn more young people on to a career in mathematical sciences, spread the word of our research and its real world impact, and communicate the wonder of mathematical and statistical sciences.

Our popular student magazine, Chalkdust, which has a global readership, exemplifies this sentiment. Chalkdust was founded by UCL mathematics PhD students and first published in 2015. Its appeal has led to articles being contributed by mathematicians and enthusiasts from across the world, and to activities such as the 2017 campaign to raise awareness of the contributions of black mathematicians to the discipline. It is our ambition to ensure Chalkdust's continued success, with the IMSS being an ideal base for its activity.

UCL Mathematics has long been at the forefront of promoting women within mathematical sciences. Twenty-five years ago, the department initiated a Women in Mathematics day, aimed at encouraging aspiring female mathematicians to study at UCL. With the ongoing commitment of staff and students, this event has run almost every year since, and is now a firmly established annual departmental event.

Past events, including Celebrating Women in Mathematics, have attracted audiences numbering over 300; and the cross-departmental meeting series UCL Women in Mathematical Sciences, which organises several events per year, is also highly subscribed. The IMSS would enable us to increase our engagement with groups that are under-represented within the discipline, and ensure that UK mathematical science attracts talent that is as diverse as possible.

Chalkdust students demonstrate machine learning to Sir David Attenborough

© Kirsten Holst

Funding the future of Mathematical Science

Two hundred years ago, a small group of pioneering philanthropists bought eight acres of land in Bloomsbury to start a new kind of university. The mathematical sciences were a keystone of this original endeavour and remain the foundation of much of UCL's problem-solving power today. The IMSS will create a world-leading, outward-looking centre for mathematical and statistical sciences at the heart of the Bloomsbury campus. It will enable the discovery of deep, important and beautiful new mathematics and foster collaborations across UCL, London and beyond. It will enhance UCL's world-leading reputation, and contribute top-level core mathematical and statistical expertise to other areas of its activity. We have the talent, ambition and location to be a world force in mathematics research, education, enterprise and outreach.

To realise this vision requires investment, in both people and infrastructure. We're asking those who value the role the mathematical sciences play in society to help us secure the future of the IMSS. The legacy of this investment will be global, wide-ranging and long-lasting, true to our founding principles and our contemporary role as London's Global University.

To find out more visit our website:
www.ucl.ac.uk/imss

"There can be fewer more productive, creative and exciting investments than investing in mathematics".

Lord Nicholas Stern, The ERA of Mathematics: an independent review of knowledge exchange in the mathematical sciences, 2018)