Linnea Christin Franssen

Contact Information

Mathematical Institute, University of St Andrews, North Haugh, KY16 9SS, UK
LCF4@st-andrews.ac.uk, www.linneafranssen.com

Research

Over 90% of cancer-related deaths arise due to secondary spread in the form of metastases. The first mathematical modelling framework that I developed to capture the interlinked processes of invasion and metastatic spread of individual cancer cells in a spatially explicit manner delivers insight into the invasion-metastasis cascade.
Computational implementation of the agent-based model using C++ confirmed, *inter alia*, the hypothesis that cancer invasion is driven by membrane-bound metalloproteases.

A three-dimensional hybrid deterministic-stochastic approach to modelling of cancer invasion by explicitly accounting for the transition from collective to individual cancer cell invasion, and vice versa, is a further focus of my research.
Inverse parameter estimation is used to infer unknown experimental parameter values and a parameter sensitivity analysis is performed. Results match *in vitro* HSC-3 cell invasion of myoma organotypic assays both qualitatively and quantitatively.

Cardiovascular haemodynamic models and prediction of evolutionary trait evolution using Adaptive Dynamics techniques are further projects I have worked on.

Publications

L.C. Franssen, T. Lorenzi, A.E.F. Burgess, M.A.J. Chaplain.
A mathematical framework for modelling the metastatic spread of cancer. B Math Biol. www.doi.org/10.1007/s11538-019-00597-x
⟶ Nominated for IMA Lighthill-Thwaites Prize

L.C. Franssen. *Using mathematics to outsmart cancer*. Mathematics Today. Vol 54(4), August 2018. pp. 135-137. Print.

Education

2016-2019 PhD in Mathematics, University of St. Andrews

Thesis: Mathematical modelling of cancer invasion and metastatic spread (Expected submission date: 26 Aug 2019)

Supervisors: Prof Mark Chaplain and Dr Tommaso Lorenzi

Funding: EPSRC research studentship (£14,500/annum, Feb 2016-Aug 2019)

Courses:
- Two C++ modules (*Programming with C++* and *Software Design*), Abertay University (graded A, 20 ECTS);
- *Advanced Methods in Applied Mathematics* and *Mathematical Models 1&2*, Scottish Mathematical Sciences Training Centre (graded A/B/A, 30 ECTS).

Awards:
- Finalist for IMA Lighthill-Thwaites Prize (2019);
- Finalist in *STEM for BRITAIN* competition held in Parliament (2019);
- Silver Badge at St Andrews' *Public Engagement Newcomer Award 2018*;
- *L'Oréal–UNESCO For Women in Science* Poster Competition Finalist (2018);
- *Holy Rood Hall of Fame Competition* Winner (2017);
- *TakeAIM 2016* public outreach competition winner (£1250).

2008-2013 MSci in Mathematics, University of Glasgow (1^{st} Class Degree)

Masters project: Windkessel and structured tree models for cardiovascular haemodynamics (Supervisor: Prof Nicholas A. Hill; graded 21/22)

Honours project: The theory of Adaptive Dynamics and its application to a mutualism-parasitism continuum Lotka–Volterra system, which involves a trade-off (Supervisor: Dr Christina Cobbold; graded 22/22)

Awards: *Matthew A Muir Bursary* (twice) and *Dougall Prize* (twice) for most distinguished student in Mathematics

1999-2008 Allgemeine Hochschulreife, Kieler Gelehrtenschule (Germany)
GPA of 1.1 (top 0.71 % in federal state in 2008)

Exchange student at Madras College, St Andrews, Scotland, in 2005
Awards: Federal prizes in Mathematical Olympiad and English competition

Conferences, Seminars & Presentations

British Applied Mathematics Colloquium (BAMC), Bath (24 April 2019)
Invited IMA Lighthill-Thwaites Prize talk: *A Mathematical Framework for Modelling the Metastatic Spread of Cancer*;

University of St Andrews School Research Day (24 Jan 2019)
Talk: *A Mathematical Framework for Modelling the Metastatic Spread of Cancer*;

SofTMech Mid-Term Review, Glasgow (24 May 2018)
Flash-talk & poster: *Mathematical Modelling of Cancer Invasion and Metastatic Spread*

Core-to-Core Meeting Mathematical Oncology (19-20 Mar 2018)
Talk: *Mathematical Modelling of Cancer Invasion and Metastatic Spread*

British Applied Mathematics Colloquium (BAMC) (26-29 Mar 2018)
Poster: *Mathematical Modelling of Cancer Invasion and Metastatic Spread*

Postgraduate Interdisciplinary Mathematics Symposium (29 Jan-1 Feb 2018)
Talk: *Using Mathematics to Outsmart Cancer* [On organising committee]

Society of Mathematical Biology Meeting, Salt Lake City (17-20 Aug 2017)

Edinburgh Mathematical Society Postgraduate Meeting (7-9 July 2017)
Talk: *Modelling Cancer Invasion using an Individual-based Game-theoretic Approach*

Postgraduate Interdisciplinary Mathematics Symposium (20-22 Jan 2017)
Talk: *An Introduction to Mathematical Biology*

Young Researchers in Mathematics Conference (1-4 Aug 2016)

Fourth Scottish Partial Differential Equations Colloquium (9-10 June 2016)

St Andrews Mathematical Biology Weekly Seminars (2016-18)
Talks:

- *Adaptive Dynamics* (5 May 2016);
- *Individual-based Game-theoretic Modelling of Cancer Invasion* (11 May 2017);
- *A Novel Mathematical Framework for Modelling the Metastatic Spread of Cancer* (13 Nov 2018).

Public Outreach

STEM for Britain (13 March 2019, House of Commons, Westminster)
Invited poster finalist: *Using Mathematics to Outsmart Cancer*

TakeAIM 2019 Award Ceremony (5 Feb 2019, Imperial College, London)
Invited video-presentation: *Taking Aim after TakeAIM – My research & how I communicate it to the public*

L'Oréal–UNESCO For Women in Science Awards (24 May 2018, London)
Invited poster finalist: *Using Mathematics to Outsmart Cancer*

Associate Researcher (by appt., £500) (Feb-May 2018, St Leonards College)
Designed curriculum for lecture series *Theory of Knowledge and Mathematics* part of International Baccalaureate Diploma Programme and delivered content as five formal interactive lectures and two tutorials

Holy Rood High School (21 Sept 2017, Edinburgh)
Invited 'Hall of Fame' Prize Talk *Mathematics in the Real World*; Seminar with (Advanced) Higher mathematics students: *Mathematics in your Future*

Ann-Tayler Day (28 Nov 2016, St Catherine's College, Oxford)
Invited video-presentation about winning 'TakeAIM' contribution: *Using Mathematics to Outsmart Cancer* (see youtu.be/plhrZLpxk_I)

Computing skills

- C++, MATLAB, Git, SQL;
- LaTeX, MS Word, MS PowerPoint, MS Excel.

Language skills

- Proficient in English and German;
- Basic knowledge of Spanish;
- Latin and ancient Greek.

Professional Skills Development

- University of Abertay computer science modules (20 ECTS):
  - *Programming with C++* (graded A);
  - *Software Design* with focus on object-oriented programming (ongoing);
- Scottish Mathematical Sciences Training Centre courses (30 ECTS):
  - *Advanced Methods in Applied Mathematics* (graded A);
  - *Mathematical Models 1&2* (graded B/A);
- Software Carpentry Workshop (2 days) covering Python, Unix shell, Git;
- Certified online courses: Python, version control, object-oriented design, C++.

Personal Development

- TEDxUniversityofStAndrews public speaking workshop (9 Apr 2017)
- Workshop for Early Career Researchers, Salt Lake City (16 Aug 2017)
- 14 university-run personal development courses, including:
  - *Adobe Illustrator: Vector graphics;*
  - *Adobe Photoshop: Photo editing;*
  - *Posters design & graphical abstracts;*
  - *'Funny research' workshop;*
  - *Media training;*
  - *Voice coaching;*
  - *Build a research website;*
  - *Mendeley.*

Work Experience

Secondary School Teacher Friedrich-Engels-Gymnasium, Berlin (Aug 2014-Oct 2015)

- Taught students aged 15 to 19 mathematics and economics;
- Drafted and marked exams according to own marking schemes;
- Supervised projects and prepared students for final exams;
- Attended 10 hours/week of teacher training.

Provinzial NordWest Life Insurance Actuarial Department, Kiel (Jan-Apr 2014)

- Acquired basic knowledge of stochastic modelling and life insurance.

Towers Watson – Intern Risk Consulting and Software, Cologne (June-July 2011)

- Derived insurance market trends using Excel and VBA;
- Analysed trends in statutory health insurance premiums;
- Researched for and developed presentations using Power Point.

INTERCOPE – Intern Development division HSM for Windows, Hamburg (June-July 2010)

- Acquired basic C++ knowledge;
- Took part in high level and graphical user interface design;
- Set up a test system.

Stadtwerke Kiel AG – Intern Service Office, Kiel (June-Aug 2009)

- Undertook computer-aided resource planning using SAP.

Teaching experience

2018 **Python Lab Demonstrator** (University of St Andrews)

- Assisted students of *MT2000: Introduction to Python* module with ad hoc problems.

2017-18 **Course Coordinator** (University of St Andrews, CAPOD)

- Co-designed curriculum for course *Key Skills in Applied Mathematics*;
- Trained honours students in deriving mathematical models in biology ($\times 2$).

2017-18 **Associate Researcher (by appt.)** (St Leonards College, £500 stipend)

- Designed curriculum for lecture series *Theory of Knowledge and Mathematics* part of International Baccalaureate Diploma Programme (TOK);
- Delivered content as five formal interactive lectures and two tutorials.

2016-18 **Session Facilitator** (University of St Andrews, CAPOD)

- Facilitated mandatory CAPOD courses *Tutoring & Demonstrating in the Sciences* ($\times 3$) and *Tutoring & Demonstrating in the Arts* ($\times 2$).

2016-17 **Teaching Assistant** (University of St Andrews)

- Delivered three sets of semester-long tutorials for undergraduate students in module *MT1002: Mathematics* and marked homework.

Representative roles

- Currently postgraduate representative on the School Safety Committee;
- Student representative for four years at the University of Glasgow;
- Year prefect during the last two years of secondary school as well as class representative and member of the student board for many years beforehand.