

Dr Gareth Kennedy, Mathematical Modeller

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Summary:

As a mathematical modeller of complex systems with a Ph.D. in astrophysics I am experienced in the core data science skills such as data mining/munging, statistical analysis and high-performance computing. For the past 7 years I have been working as a postdoctoral researcher in Australia, Spain and China in astrophysics, computational electrochemistry and geophysics. This provided a rich variety of experiences and led to overcoming many challenging problems requiring novel technical approaches and effective skills for communicating with non-expert audiences.

Technical skills:

- **Data analysis:** 7 years of professional experience using self-written software to analyse large data sets producing clear and insightful results. These results were the basis of numerous research papers.
- **Data software skills:** experienced using Python for image processing and pattern recognition in my own projects (see <http://garethkennedy.net/BeijingMaking.html>); and R to analyse large data sets producing simple visually appealing results (see <http://garethkennedy.net/AQIStats.html>).
- **Statistics:** I frequently write code to implement statistical analyses in astrophysics, geophysics and electrochemistry; especially utilising Bayesian statistics and hypothesis testing.
- **Communication:** considerable experience communicating complex concepts and results to a wide range of audiences, from international experts to primary school students. A recent example of this was a **TEDx Youth** talk I gave in Beijing (4/2015) entitled “Chaos. Order. Beauty.” (see <https://youtu.be/MzFHPyURIQw>).
- **Simulation support:** continue to provide support and updates to the electrochemical simulation package I developed (called MECSim) which has enabled the work of researchers from around the world. About 20 known articles are listed here <http://garethkennedy.net/MECSimPubs.html>
- **Programming:** extensive experience with Python, C, Fortran (77 and 90), Unix based scripting languages and past use of MS Office tools (Visual Basic and Excel). Some experience with MySQL.
- **Parallel/GPU computing:** significant experience using OpenMP/MPI and using CUDA with C.
- **Visualisation:** extensive use of Python and R modules as well as open source tools.
- **Languages:** Native English; basic Spanish, German and Chinese (Mandarin).

Professional Experience:

5/2015 – present: Postdoctoral Research Fellow (Mathematical Modelling in Geophysics) School of Earth Sciences, University of Melbourne

- Development of the Python front end layer for the underworld geophysics software (see github for the code and links <https://github.com/underworldcode/underworld2>).
- Training students and researchers by running workshops and tutorial sessions.

7/2012 – 1/2015: CAS Postdoctoral Research Fellow (Astrophysics) National Astronomical Observatories of China, Chinese Academy of Sciences, Beijing

- Development of GPU code (using C and CUDA) to run complex mathematical models of the galactic centre which include star and gas dynamics.
- Exploration of the limitations of scaling for CPU and GPU clusters using the NAOC cluster Laohu

- (老虎) consisting of 59 Kepler K20 GPUs and 48 Tesla C1060 GPUs.
- Giving presentations to a variety of audiences (technical, general and public) in a range of countries (e.g. China, Germany, Spain, Kazakhstan, U.K., Australia).

1/2011 – 5/2012: Postdoctoral Researcher (Mathematical Modelling in Chemistry) School of Chemistry, Monash University, Melbourne, Australia

Developed the Monash Electrochemistry Simulator (MECSim) software package which models a large variety of electrochemical processes. Such processes are used in a wide range of applications such as biosensors detecting the level of glucose in patients with type II diabetes. This project required:

- building MECSim from the ground up as a side project during my Ph.D. candidature
- writing new computational algorithms to solve complex, project specific mathematical problems
- good communication and collaboration with users without mathematical backgrounds
- maintaining and adding to the software over the years – there is a November 2015 release.

I was the sole developer of this software, which has subsequently been accepted as best practice. The MECSim software is freely available on my webpage (<http://www.garethkennedy.net/MECSim.html>) and has been successfully used by scientists worldwide to model complex chemical processes.

12/2008 – 12/2010: Postdoctoral Researcher (Astrophysics) Institut de Ciències del Cosmos, Universitat de Barcelona, Barcelona, Spain

Used my skills in mathematical modelling, astrophysics and high performance computing to build a model of the galactic centre with limited computational resources. Built and optimised a parallel N-body code using Fortran 77 with OpenMP libraries for a small 8 node CPU cluster.

Education:

- **Ph.D. in Astrophysics** from the Centre for Stellar and Planetary Astrophysics, Monash University, Melbourne, Australia (March 2003 - November 2008; Graduated March 2010)
Thesis title: "*Problems in stellar and planetary dynamics*"; Advisor: Rosemary Mardling
- **B.Sc. (Hons): Astrophysics** (2001)
Awarded the Astrophysics prize for the highest grade in the year
- **B.Sc.: Majored in Astrophysics and Applied Mathematics** (2000)

Management and organisational experience:

- Part of the local organising committee (LOC) for the International Astronomical Union (IAU) Symposium 312 held in Beijing (August 2014).
- Lead author and organiser for scientific collaborations across multiple countries.
- Aided in the supervision of many Ph.D. and Masters students in Melbourne, Barcelona and Beijing.
- Closely supervised a summer student in Beijing now a software developer at SpaceX.

Communication experience

- Public speaking at a TEDx Youth event: <https://youtu.be/MzFHPyURIQw>
- Have given invited scientific talks in many countries throughout Europe and Asia.
- Tutoring and lecturing at Monash university (mostly mathematics and astrophysics) 2001 – 2007.
- Have written many **scientific peer-review papers** (including as first and sole author) as well as enabling many more. See web-page for expanded list here <http://garethkennedy.net/Publications.html>
- Ran for and organised a campaign for the Victoria state election politics in 2002 (<http://www.vec.vic.gov.au/Results/state2002resultCranbourneDistrict.html>).