

Emma Hart Edinburgh Napier University

Short CV

Emma Hart is a Professor in Computing Science at Edinburgh Napier where she leads the Nature-Inspired Intelligent Systems research group within the School of Computing. She holds a PhD from the University of Edinburgh, UK in Artificial Immune Systems. Her research interests lie in meta-heuristic methods for optimisation and learning, specifically in the areas of (1) combinatorial optimisation and (2) evolutionary Robotics. She has attracted significant funding in this field, currently leading a large project in Evolutionary Robotics to co-evolve robot brains and bodies. She is particularly interested in methods that integrate methods from evolution and machine-learning to provide mechanisms for adaptation and life-long learning. She is Editor-in-Chief of Evolutionary Computation (MIT Press), one of the leading journals in the field, and an Associate Editor of the ACM Transactions on Evolutionary Learning and Optimization. She is also an elected member of the executive board of the ACM interest group on evolutionary computation (SIGEVO). In Scotland, she leads the SICSA (Scottish Informatics and Computer Science Alliance) cross-university pooling initiative in Artificial Intelligence, and is a member of the Steering Group set up by the Scottish Government to oversee development of a new AI Strategy for Scotland. She is a regular member of program committees for the main conferences in our field GECCO, PPSN, CEC and was General Chair of PPSN in 2016.

Google Citations profile: <https://scholar.google.co.uk/citations?user=hyFlq8UAAAAJ&hl=en>

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Research group

The Nature Inspired Intelligent Systems group (NIIS) is one of two groups in the interdisciplinary centre for Artificial Intelligence and Data Science. The vibrant group of 8 academic staff, 3 post-docs and around 6 current PhD students.

The group takes inspiration from processes observed in natural systems to build computational systems that are capable of problem solving – tackling problems that range from optimising processes, through engineering design, to enabling groups reach socially beneficial outcomes, e.g. by reducing energy consumption. A number of members focus on combinatorial optimisation problems, with expertise in logistics (vehicle-routing), workforce scheduling, timetabling and packing. While in many applications, optimisation leads to considerable economic benefits, our work has a particular emphasis on reducing carbon-emissions and sustainable travel. We combine evolution with machine-learning techniques to improve algorithm selection and develop optimisation systems that exhibit life-long learning, capable of automatic algorithm generation and improvement through application of genetic programming methods.

Evolution also inspires our work in robotics, as a tool to design and build novel robots for use in unknown-environments, and as a method to develop adaptive robot behavioural mechanisms, that enable robot(s) to remain fit-for-purpose in dynamically changing environments, and to collaborate to achieve tasks more efficiently.

We study also human behaviour, and use this understanding to engineer socio-technical systems. Evolutionary game theory combined with agent-based-modelling and models of social learning and cultural evolution are used to understand how groups can create institutions and solve social dilemmas, which influences the design of socio-technical

systems such as smart grids and peer-2-peer clouds. Finally, one-shot learning techniques (the ability of a system to learn a new concept from a single or very few examples) are used to understand and generate language in the context of situated dialogue (i.e. human-robot interaction).

Projects

1. (Co) Evolution of Morphology and Controllers in robotics
2. Quality-Diversity algorithms for generating diverse solutions in combinatorial optimisation
3. Algorithm Selection for meta-heuristics, leveraging a range of machine-learning approaches
4. Evolution of algorithm portfolios which exhibit diversity of behaviours
5. Lifelong learning in optimisation: methods for continual adaptation of algorithms based on problem-solving experience

About the university and the city

Now home to over 19,500 students from over 140 countries, Edinburgh was officially inaugurated as a University in 1992., However our story goes back to the time of John Napier, the brilliant 16th-century mathematician and philosopher from whom we take our name and whose original residence now forms an integral part of our Merchiston Campus (one of 3 campuses spread around the city). The School of Computing is located at Merchiston, in the south-west of the city, an area renowned for its many cafes and restaurants and a short walk from the city centre. Edinburgh. It's probably one of the few cities in the world to have an extinct volcano in its centre, and is known world-wide for hosting a unique range of festivals, including the Edinburgh Fringe, an International Science Festival and an annual Jazz and Blues Festival.