Faculty of Engineering
School of Computing
Algorithms and Complexity

Research Fellow in Train Unit Scheduling (Hybridised Optimisation)
(Fixed Term, 29 months)

You will be one of two Research Fellows, working on a 36 month EPSRC funded project on Train Unit Scheduling Optimisation, the aim of which is to derive efficient practical methods for producing train unit schedules that are operable in real life practice. Work on this project has already begun. Therefore, you will work on this project for the remaining 29 months.

Efficient passenger rail services, critical to the UK economy, require optimised operations planning. Well before a timetable goes live, train unit scheduling is part of resource planning as to how the daily train services would be covered. A train unit is assigned a sequence of timetabled journeys ensuring all the connections are feasible, both in terms of time and physical constraints. The problem is like an enormous jigsaw puzzle balancing between minimising the train unit resources and satisfying passenger demands and operational constraints.

This project builds on successful research collaboration with First ScotRail and Tracsis Plc. It has three parallel work streams. The planned research is grounded on an exact mathematical approach, under which advanced solution techniques and appropriate formulation variations are sought to improve and refine its computational performance. The other Research Fellow will be responsible for this work stream. However, while the mathematical approach has superior optimisation power, computational time escalates exponentially to becoming impractical beyond small to medium sized problem instances. In another work stream, you will investigate a new method that could make a step change. Recognising that there is a practical limit on how large a problem instance the mathematical optimiser can solve 'comfortably', you will be mainly developing heuristics for compressing the problem instance into a much smaller one to be solved mathematically. The working solution is improved in heuristic iterations and this hybridised optimisation approach has already been successfully used for train crew scheduling.

With a PhD (or near completion) in a relevant subject, you will have a track record in the design and implementation of heuristics or meta-heuristics search algorithms for practical problem solving. You will have research experience in formulating and solving integer linear programming models. You will also have programming skills for algorithmic development.

‘The University of Leeds’ commitment to women in science has been recognised with a national accolade. The University and the Faculty of Engineering have received the Athena SWAN Bronze Award in recognition of our success in recruiting, retaining and developing/promoting women in Science, Engineering and Technology (SET).’
The University offers generous terms and conditions of employment, a wide range of benefits, services, facilities and family friendly policies. Full details are available on the Human Resources web pages accessible at www.leeds.ac.uk/hr/index.htm

University Grade 7 (£31,656 - £37,768 p.a.)

Informal enquires to Dr Raymond Kwan, Senior Lecturer, tel +44 (0)113 343 5760, email R.S.Kwan@leeds.ac.uk.

Job Reference: ENGCP1015

Click here for further information about working at the University of Leeds www.leeds.ac.uk/info/20025/university_jobs
Job Description

Responsible to: Head of School
Reports to: Dr Raymond Kwan, Senior Lecturer

Job Summary

You will be one of two Research Fellows, working on a 36 month EPSRC funded project on "Train unit scheduling optimisation", the aim of which is to derive efficient practical methods for producing train unit schedules that are operable in real life practice. Work on this project has already begun. Therefore, you will continue the research work for the remaining 29 months

Efficient passenger rail services, critical to the UK economy, require optimised operations planning. Well before a timetable goes live, train unit scheduling is part of resource planning as to how the daily train services would be covered. A train unit is assigned a sequence of timetabled journeys ensuring all the connections are feasible, both in terms of time and physical constraints. The problem is like an enormous jigsaw puzzle balancing between minimising the train unit resources and satisfying passenger demands and operational constraints.

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While the mathematical approach has superior optimisation power, computational time escalates exponentially to becoming impractical beyond small to medium sized problem instances. In another work stream, you will investigate a new method that could make a step change. Recognising that there is a practical limit on how large a problem instance the mathematical optimiser can solve 'comfortably' a heuristics is used to compress and transform the problem instance into a much smaller one for the mathematical solver to be applied. Over a number of cycles, more and more is learnt about the key data points to be retained in the compressed instance whereby the hybridised algorithm would converge to the optimal or very near optimal solution.

In the third work stream, both Research Fellows will be engaged in activities with our industrial collaborators to ensure that the most realistic model is built, the solution schedules produced are fully operable and testing and evaluation are as thorough as possible. The activities include short placements, regular contacts, on-site testing/evaluation and three seminar workshops that other train companies will also be invited to.

Background

The EPSRC grant EP/M007243/1 for the 36-month project "Train unit scheduling optimisation" requires two full-time Research Fellows to carry out its work plan.

The School of Computing is ranked in the top 10 computing departments in the UK based on the quality of its research (2008 Research Assessment Exercise); with an impressive 80% of research activity rated as internationally excellent or World leading.

The School has an established track record of high quality research in the foundations of computer science and in a variety of applied and multidisciplinary settings with particular expertise in the areas of Artificial Intelligence, Biological Systems and Computational and Systems Sciences.
With 70 academic and research staff and over 400 students the School is a major player in the field of computer science.

**Main Duties and Responsibilities**

- To undertake research within the remit of the project, managing aspects of the project, coordinating work with colleagues and collaborators, and making significant contributions to your specific research topics as well as to the integration of the project.
- To pursue cutting-edge research of international standing and enhance the research activity of the group.
- To develop and maintain a record of high-quality, original research.
- To develop and maintain a high-quality record of publications in independently peer-reviewed journals of a high international standing.
- To present the research in international meetings and conferences.
- To work effectively both independently and as part of a team.
- To attend and present work in group meetings to report progress, agree future work and exchange data/experience.
- To provide leadership, guidance, and assistance to others in the group.
- If appropriate, to play a role in the supervision of undergraduate, MSc and PhD students.
- To ensure good progress is maintained and work is undertaken in a systematic way that is well documented.
- To identify other research project opportunities and directions as they arise.
- To liaise with the industrial partners and appropriately present the required results to a high standard.
- To build collaborations with other academics and external stakeholders as appropriate.
- To ensure satisfactory compliance in your work with respect to Health and Safety, standard operating procedures, quality assurance procedures, data management and scientific ethical conduct.
- Any other duties in relation to the research activities of the School, as directed by the Principal Investigator of the research project, commensurate with the grade of the post.
- To work and liaise closely with and report to the Principle Investigator, Dr Raymond Kwan.

**Career Expectations**

The University of Leeds is committed to developing its staff. All staff participate in the Staff Review and Development scheme and we continue to work with individuals supporting them to maximise their potential.

Progression to a higher grade is dependent on an individual taking on an increased level of responsibility. Vacancies that arise within the area or across the wider University are advertised on the HR website - [http://hr.leeds.ac.uk/jobs/](http://hr.leeds.ac.uk/jobs/) - to allow staff to apply for wider career development opportunities.
Key Working Relationships

You will work closely with the Principal Investigator, Raymond Kwan, the industrial collaborators, First Rail Holdings Ltd, Tracsis Plc, and the project’s Research Fellow in Train Unit Scheduling (Mathematical Programming).

University Values

All staff are expected to operate in line with the University’s values and standards, which work as an integral part of our strategy and set out the principles of how we work together. More information about the University’s strategy and values is available at http://www.leeds.ac.uk/comms/strategy/
Person Specification

Essential

- A PhD or near completion of a PhD in a relevant subject (including, but not limited to, transport scheduling, combinatorial optimisation, meta-heuristics search and computer science)
- A track record in the design and implementation of heuristics or meta-heuristics search algorithms
- Research experience in formulating and solving integer linear programming models
- Programming skills for algorithmic development in C# or similar languages
- Ability to undertake independent high quality research and to carry through research projects from inception to publication delivering against deadlines
- A track-record of high quality peer-reviewed publications, commensurate with experience
- A high level of interpersonal and communication skills, including written and presentational. Experience of preparing and delivering presentations at scientific conferences
- The potential to develop new research themes
- Excellent organisational skills, including the ability to manage time effectively, prioritise tasks, and to work under pressure
- Ability to work effectively, responsibly, independently, and as a member of a team

Desirable

- Knowledge of rail operations and resource planning/scheduling
Additional information

The University offers generous terms and conditions of employment, a wide range of benefits, services, facilities and family friendly policies. Full details are available on the Human Resources web pages accessible at www.leeds.ac.uk/hr

The Partnership

The Partnership has been developed by students and staff and describes the mutual expectations of us all as members of the University of Leeds community. More information about the Partnership is available at http://partnership.leeds.ac.uk

Disclosure and Barring Service Checks

A Disclosure and Barring Service (DBS) Check is not required for this position. However, applicants who have unspent convictions, cautions, reprimands and warnings, including any pending criminal proceedings must indicate this in the 'other personal details' section of the application form and send details to the Recruitment Officer at disclosure@leeds.ac.uk.

Disabled Applicants

The post is located in the School of Computing. Disabled applicants wishing to review access to the building are invited to contact the department direct. Additional information may be sought from the Recruitment Officer, email disclosure@leeds.ac.uk or tel + 44 (0)113 343 1723.

Disabled applicants are not obliged to inform employers of their disability but will still be covered by the Equality Act once their disability becomes known.

Further information for applicants with disabilities, impairments or health conditions is available in the applicant guidance.
Further information about the Faculty and School

Top 100 university for Engineering and Technology - Times Higher World University Rankings 2014.

The Faculty of Engineering is one of the largest engineering groupings in the UK with over 700 staff, 3,000 students and an annual turnover of around £60m.

Our focus is on providing research based teaching and supervision, inspiring our students and through this helping our students to achieve their goals and ambitions.

The range and scope of the our research is extensive and covers all of the major engineering disciplines, including cross cutting themes such as energy, materials, medical engineering and artificial intelligence, with theoretical, experimental and modelling work underpinning all areas.

This provides an ideal platform for multidisciplinary research, enabling us to undertake high-impact research in areas recognised as providing critical global challenges. Much of our research is linked to industry, with major collaborators throughout the UK and Europe. We have also aligned our Faculty with industry sectors such as digital technologies, energy, high value chemicals and medical technologies, and undertake further interdisciplinary research in areas as diverse as functional materials, robotics and water.

Teaching and research is delivered through the following five schools:

- School of Chemical and Process Engineering
- School of Civil Engineering
- School of Computing
- School of Electronic and Electrical Engineering
- School of Mechanical Engineering

There is a friendly atmosphere and student-focused approach to undergraduate and postgraduate education. We pride ourselves on the professionalism of our staff and the quality of the research environment, promoting excellence by offering a range of cutting edge programmes, many in conjunction with industrial sponsors and collaborators.

School of Computing

The School of Computing is a leading international centre for computing research, with 86% of its research activity rated 3* and 4* in the UK 2014 REF. The School has demonstrated excellence in interdisciplinary and applied research based upon an outstanding fundamental core; achieved through a focus on our strengths in fundamental computing, artificial intelligence and computational science. Research grants have been obtained from the European Union, each of the seven UK Research Councils, government departments, and many industrial sources as well as other overseas sources.

Globally renowned for our teaching, research and engagement with industry, we are one of the longest established computing schools in the UK.

- Ranked 16th in the UK for Computer Science by The Times and Sunday Times University League Table 2015.
- BSc Computer Science is accredited by the relevant professional bodies (check website for full details).
• Over 300 students from 40 countries.

• The following undergraduate degree courses: Computer Science, Computer Science with Artificial Intelligence and Computer Science with Distributed Systems have a common first year that focuses on the fundamentals of programming and the underlying mathematical principles of computer science. A key benefit of having a common first year is that you can easily switch between these programmes.

• Research feeds directly into teaching, which means students will learn about the latest developments within their subject from world-class academics.

• The School has an established track record for delivering high quality research with over 86% of research activity rated as ‘world leading’ or ‘internationally excellent’ by the Research Excellence Framework (REF2014). (UoA: Computer Science and Informatics)

• 90% of our recent graduates have successfully secured a professional or managerial role within six months of graduating – for example we have graduates working for IBM, BT, Lloyds Banking Group, KPMG, PepsiCo and Microsoft. (This is based on results from the latest (2013) Destinations of Leavers from Higher Education survey and relate to graduates who have completed an undergraduate degree.)

• 87% overall student satisfaction in the National Student Survey (NSS).

• The School has strong industrial links which has resulted in our students undertaking work placements at Microsoft, IBM, BT and Fujitsu.

• Access to specialist facilities including a high-resolution powerwall display, a dedicated 3D virtual reality suite and our new cloud computing testbed.