

THE UNIVERSITY OF MANCHESTER
PARTICULARS OF APPOINTMENT
FACULTY OF SCIENCE & ENGINEERING
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF MATHS
NUMERICAL ALGORITHMS DEVELOPER (KTP ASSOCIATE)
VACANCY REF: S&E-14966

Salary: Grade 6 £32,861 to £40,322
Hours: Full-time
Duration: Fixed term for 30 months
Location: Arup, 3 Piccadilly Place, Manchester, M1 3BN

Enquiries about the vacancy, shortlisting and interviews:

Name: Professor Françoise Tisseur
Email: francoise.tisseur@manchester.ac.uk
Telephone: +44 (0)161 275 5823

BACKGROUND

This is an exciting opportunity for an enthusiastic post-doctoral graduate with the ability and confidence to manage a 30-month collaborative project with the Department of Mathematics at The University of Manchester and Arup, a multidisciplinary engineering firm operating in all areas of built environment.

The aim of the KTP is to develop and embed high-performance implementations of leading edge algorithms from numerical linear algebra into Arup's next generation software for finite element structural engineering simulation. These algorithms will enable structural engineers to carry out faster and more accurate analysis, leading to safe and sustainable design of buildings, bridges, and other infrastructure.

You will be responsible for integrating modern sparse linear algebra algorithms into this software. The role covers all aspects of developing a high-performance technical software in a modern

commercial-software development environment in close collaboration with academic experts and end-user domain experts.

The Department of Mathematics at the University of Manchester is one of the largest integrated departments of mathematical sciences in Europe, with about 90 academic staff, 1500 students and around £3M of research income in 2018. Its research interests cover the entire breadth of pure and applied mathematics, including probability and statistics. The Numerical Analysis Group, with 8 permanent staff, is one of the largest and most active in the world. [Group members](#) are internationally renowned for their work in Numerical Linear Algebra and numerical algorithms.

[Arup](#) is a multidisciplinary engineering firm operating in all areas of built environment. It is behind the structural design of some key landmarks across the world including Sydney Opera house, Beijing Olympic stadia, the London Eye and locally the Manchester City stadium and Manchester University's Engineering Campus. The firm has been developing engineering analysis software under the Oasys name for over 40 years. [Oasys GSA](#) is Arup's flagship commercial finite element suite that is not only used on its projects worldwide but also sold commercially to an international customer-base. Arup has a rich tradition of academic collaboration to stay at the forefront of innovation. GSA is no exception to this and the development team maintains close ties with academia especially the Numerical Analysis Group.

This post offers the unique opportunity to work in an exciting company alongside the developers and users of Oasys GSA. In addition, you will also be integrated in the Numerical Linear Algebra Group, supported by Dr Stefan Güttel, Professor Nick Higham, and Professor Françoise Tisseur. As well as a competitive salary, you will have access to a personal development budget and several training opportunities.

Overall Purpose of the Job:

You will be incorporating new sparse linear algebra solvers into Oasys GSA. GSA offers both desktop- and cloud-based modelling and simulation for structural engineers. The program is written in modern C++ supported by software development processes representing industry best-practices. The role includes developing software, interacting with and eliciting knowledge from expert end-users, and disseminating your work to a variety of forums. You will be embedded within the GSA software development team in the Digital Development group, which develops a variety of software products for the civil engineering market including structural, geotechnical and pedestrian simulation software. In particular, you will:

- Benchmark and compare numerical performance of existing eigensolvers and make recommendations for optimizing their performance;
- Implement the [Mass Accumulating Shift-and-Invert Lanczos](#) (MASIL) algorithm developed at the University of Manchester;
- Develop a quadratic eigensolver for structural mechanics problems and
- Implement algorithms to optimize the placement of dampers in structures.

Knowledge Transfer Partnerships (KTP) is Europe's leading programme helping businesses to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK knowledge base. Throughout the KTP you will:

- Receive a competitive salary
- Gain excellent experience of managing a high profile project
- Receive formal management training
- Have access to a £5,000 professional development and training budget
- Receive mentoring and support from academic staff and industry professionals

Further information on KTP, including case studies, can be found at:

<http://www.manchester.ac.uk/collaborate/business-engagement/knowledge-exchange/transfer-partnerships/>

Key Responsibilities, Accountabilities or Duties:

The range of duties includes:

- Design and implement high-performance numerical linear algebra algorithms and embed into GSA.
- Liaise with Oasys GSA software developers and Arup's structural engineers to elicit knowledge and develop an understanding of modelling problems and needs.
- Validate and verify the resultant software to rigorous standards.
- Develop automated tests within the existing Oasys test framework to minimize regression and ensure compliance with Oasys ISO QA procedures.
- Provide a clear program/algorithm documentation.
- Proactively project-manage own work including reporting progress on a regular basis to the team and wider stakeholders.
- Maintain the integrity and quality of program codebase by adopting team practices: participating in code reviews, use of coding standards, and version control.
- Disseminate own work
 - Periodically present to members of the local management committee
 - Create blogs/presentations to inform and educate end-users.
 - Contribute to articles, publications, and reports for academic and industry audiences.
 - Transfer knowledge and expertise to embed knowledge amongst Oasys GSA developers
- Occasionally travel to other Arup offices to meet with development team members and engineers as needed.
- Participate in compulsory management courses, as prescribed by the Knowledge Transfer Partnership (KTP) programme.
- Perform administrative duties as required, including organising local management committee meetings.
- Continue to update knowledge and develop skills.
- Plan own day-to-day development activity within the framework of the agreed programme.
- Make active use of the provided resources for personal development.

PERSON SPECIFICATION

It is **essential** that you:

- Have a PhD in
 - applied mathematics or computer science with significant numerical component or,
 - an engineering discipline with a significant numerical component such as computational mechanics.
- Have an interest and aptitude to understand computational problems within engineering and a desire to provide solutions.
- Have experience of developing and/or using numerical algorithms, preferably in a numerical linear algebra setting.
- Have experience with at least one compiled language used in high-performance technical computing such as C++/C/Fortran.
- Have good communication and presentational skills, both spoken and written.
- Have good team working skills, are generous with sharing your knowledge and curious about the work of others.
- Are able to work independently, self-driven and self-motivated with good project management and time-management skills.
- Are committed to meet deadlines.

It is **desirable** that you

- Have experience with a scripting language such as MATLAB or Python.
- Have experience working with industry standard linear algebra libraries such as LAPACK, Intel MKL, and Eigen.
- Are interested in software performance optimization and communication reducing linear algebra techniques.
- Have some understand of the problem domain, in this case finite element structural analysis.
- Have an appreciation of good practices in software engineering.