Jobbnorge ID: 263840
Deadline: 6/23/2024
Website: http://www.ntnu.no
Scope: Fulltime
Duration: Temporary

The Department of Structural Engineering has a vacancy for a

PhD candidate in modelling the stochastic fracture behaviour of aluminium castings

This is NTNU

NTNU is a broad-based university with a technical-scientific profile and a focus in professional education. The university is located in three cities with headquarters in Trondheim.

At NTNU, 9,000 employees and 43,000 students work to create knowledge for a better world.

You will find more information about working at NTNU and the application process here.

Video: https://youtu.be/Xt-yHCN5QS0

About the job

At the Department of Structural Engineering, NTNU, we have two vacant PhD positions in modelling of stochastic fracture in aluminium castings. The positions are linked to the research group SIMLab (Structural Impact Laboratory).

For a position as a PhD candidate, the goal is a completed doctoral education up to an obtained doctoral degree.

Context and motivation

Structural metals are typically produced using a series of forming processes and heat treatments. This leaves the material with a reduced level of microstructural heterogeneity and a rather deterministic fracture behaviour that is often accurately predicted by state-of-the-art ductile fracture models. Standard production processes, such as rolling and extrusion, are however limited to producing parts and components of simpler shapes and geometries, and end products usually consists of multiple components assembled using various joining techniques. An alternative is to produce structural parts in a single process using casting or additive manufacturing, which greatly reduces the need for forming and joining operations. An example of this is the increasing use aluminium castings in the automotive industry.

Aluminium castings are lightweight, durable, strong, and corrosion resistant materials with high thermal and electrical conductivity. There are several ways to produce aluminium castings. High-pressure die casting is a frequently used casting technique, in which molten aluminium is injected into a die mould under high pressure. This process enables low-cost and high-volume production of parts with complex geometries yet offering high precision, dimensional stability, and excellent surface finish. Also, aluminium castings are more easily recycled without compromising their initial properties, which makes them a promising candidate for sustainable design and production. The favourable properties of aluminium castings have made them popular in a wide variety of industrial applications today, such as for light-weighting of vehicles in the automotive and aircraft industry, in consumer and sport goods, electronic devices, and medical equipment. With today's increasing emphasis on reducing environmental impact of industrial processes and products, aluminium castings are likely to remain an essential material in various industries in the future, one example being to improve the light-weighting of electrical vehicles.

Despite all their beneficial properties, aluminium castings exhibit a stochastic fracture behaviour influenced by several factors, e.g., casting defects, porosity, impurities, grain structure irregularities, and thermo-mechanical processing. The microstructural defects could act as stress concentrators or weak zones where fracture initiates. This ultimately leads to a significant variation in the fracture properties of the material, even among samples of the same material. Moreover, the probability of failure is not constant but depends on factors such as the applied stress, sample size and distribution of the defects. Therefore, predicting the fracture behaviour of a metal under different loading conditions requires a probabilistic approach that considers the inherent variability and uncertainty in the material properties, which cannot be modelled using common deterministic fracture models. The stochastic fracture behaviour is currently not well understood, which poses several challenges for the design and structural integrity assessment of aluminium castings. This underscores the need for further studies of the underlying physical mechanisms for fracture in aluminium castings to develop more accurate fracture models.

These two PhD positions are parts of a project devoted to study the microstructural origin of the stochastic fracture behaviour of aluminium castings and to establish predictive microstructural-based models for plastic flow and fracture. The research activities in the project will involve extensive experimental work combined with numerical simulations at different scales. Hydro Aluminium and Honda are research partners in the project.

Objectives and scope

The overarching goals of the project are to bring more clarity into what microstructural defects govern the stochastic fracture behaviour of aluminium high-pressure die castings and to establish predictive models at different relevant material length scales. Experiments will be conducted to examine the fracture behaviour of commercially relevant high-pressure die-casting aluminium alloys under various loading conditions. An important aspect is the design of specimens that permits us to distinguish the influence of activation volume and stress state on fracture and the use of advanced measurement techniques and data analysis tools to enhance the utilization of experiment data.

The two PhD positions will be complementary but have different focus:

- **PhD position 1**:

This position will focus on micromechanics-based computational modelling of the stochastic fracture behaviour in aluminium castings. The research activities will primarily concern numerical modelling and simulations, e.g., combining finite element-based microstructural models with crystal plasticity, non-local damage models, or phase-field models.

- **PhD position 2**:

This position will focus on experimental work and numerical modelling of stochastic fracture at a larger scale. The main objectives of this position are to design and conduct experiments that will help us to better understand the stochastic fracture behaviour of aluminium castings, and to use the experimental data for numerical simulations and developing more predictive fracture models. An important aspect is to use advanced measurement techniques and data analysis tools to enhance the utilization of experimental data.

If you wish to apply for only one of the positions, this should be specified in your application.

Your immediate leader is Associate Professor Lars Edvard Blystad Dæhli. In addition, the team of supervisors consists of Professor Odd Sture Hopperstad and Associate Professor David Morin, all members of the SIMLab research group at the Department of Structural Engineering, NTNU.

Duties of the position

- Contribute towards excellent research at the Department of Structural Engineering
- Conduct research aiming to:
  - Improve the current understanding of stochastic fracture behaviour in aluminium castings
  - Develop predictive stochastic fracture models for large-scale applications
- Disseminate relevant parts of the research to a wider audience

Required selection criteria

- You must have a professionally relevant background in solid mechanics, structural engineering or mechanical engineering
- Your education must correspond to a five-year Norwegian degree program, where 120 credits are obtained at master's level
- You must have a strong academic background from your previous studies and an average grade from the master's degree program, or equivalent education, which is equal to B or better compared with NTNU's grading scale. If you do not have letter grades from previous studies, you must have an equally good academic basis. If you have a weaker grade background, you may be assessed if you can document that you are particularly suitable for a PhD education
- You must meet the requirements for admission to the doctoral program from the Faculty of Engineering
- You must be fluent in spoken and written English

The appointment is to be made in accordance with Regulations on terms of employment for positions such as postdoctoral fellow, Phd candidate, research assistant and specialist candidate and Regulations concerning the degrees of Philosophiae Doctor (PhD) and Philosodophiae Doctor (PhD) in artistic research national guidelines for appointment as PhD, post doctor and research assistant

Preferred selection criteria

- Knowledge of plasticity theory
- Knowledge of non-linear finite element methods
- Knowledge of fracture mechanics theory
- Knowledge of constitutive modelling of materials
- Knowledge of statistical methods, e.g., Monte-Carlo analysis
- Experience using non-linear finite element software, e.g., Abaqus
- Experience with programming using Python and Fortran
- Experience with conducting experimental work and data processing
- Experience with simulations of casting processes

Personal characteristics

- Good cooperation skills
- Motivated and ambitious
- Curious, creative and eager to learn

Emphasis will be placed on personal and interpersonal qualities.

We offer

- exciting and stimulating tasks in a strong international academic environment
- an open and inclusive work environment with dedicated colleagues
- favourable terms in the Norwegian Public Service Pension Fund
- employee benefits

Salary and conditions

As a PhD candidate (code 1017) you are normally paid from gross NOK 532 200 per annum before tax, depending on qualifications and seniority. From the salary, 2% is deducted as a contribution to the Norwegian Public Service Pension Fund.

The period of employment is three years.

Appointment to a PhD position requires that you are admitted to the PhD programme in Engineering within three months of employment, and that you participate in an organized PhD programme during the employment period.

The engagement is to be made in accordance with the regulations in force concerning State Employees and Civil Servants, and the acts relating to Control of the Export of Strategic Goods, Services and Technology. Candidates who by assessment of the application and attachment are seen to conflict with the criteria in the latter law will be prohibited from recruitment to NTNU. After the appointment you must assume that there may be changes in the area of work.

Please note that the candidate holding the announced position is expected to work with critical infrastructure and areas affected by control of the export of strategic goods, services and technology. Candidates with the potential of not fulfilling requirement for security clearance, access clearance and authorization as described in the Act Relating to National Security, The Export Control Act and Act on the Implementation of International Sanctions (Sanctions Act) cannot be considered for the position (e.g., candidates from Russia, Iran, North Korea, China among other countries).

One of the positions is subject to external funding.

It is a prerequisite you can be present at and accessible to the institution daily.

About the application

The application and supporting documentation to be used as the basis for the assessment must be in English.

Publications and other scientific work must be attached to the application. Please note that your application will be considered based solely on information submitted by the application deadline. You must therefore ensure that your application clearly demonstrates how your skills and experience fulfil the criteria specified above.

The application must include:

- CV and certificates
- transcripts and diplomas for bachelor's and master's degrees. If you have not completed the master's degree, you must submit a confirmation that the master's thesis has been submitted.
- Name and contact information of three referees
- If you have publications or other relevant research work
- A specification of which position you apply for, if you do not apply for both

If all, or parts, of your education has been taken abroad, we also ask you to attach documentation of the scope and quality of your entire education, both bachelor's and master's education, in addition to other higher education. Description of the documentation required can be found here. If you already have a statement from NOKUT, please attach this as well.

We will take joint work into account. If it is difficult to identify your efforts in the joint work, you must enclose a short description of your participation.

In the evaluation of which candidate is best qualified, emphasis will be placed on education, experience and personal and interpersonal qualities. Motivation, ambitions, and potential will also count in the assessment of the candidates.

NTNU is committed to following evaluation criteria for research quality according to The San Francisco Declaration on Research Assessment - DORA.

General information

Working at NTNU

NTNU believes that inclusion and diversity is our strength. We want to recruit people with different competencies, educational backgrounds, life experiences and perspectives to contribute to solving our social responsibilities within education and research. We will facilitate for our employees' needs.

NTNU is working actively to increase the number of women employed in scientific positions and has a number of resources to promote equality.

The city of Trondheim is a modern European city with a rich cultural scene. Trondheim is the innovation capital of Norway with a population of 200,000. The Norwegian welfare state, including healthcare, schools, kindergartens and overall equality, is probably the best of its kind in the world. Professional subsidized day-care for children is easily available. Furthermore, Trondheim offers great opportunities for education (including international schools) and possibilities to enjoy nature, culture and family life and has low crime rates and clean air quality.

As an employee at NTNU, you must at all times adhere to the changes that the development in the subject entails and the organizational changes that are adopted.

A public list of applicants with name, age, job title and municipality of residence is prepared after the application deadline. If you want to reserve yourself from entry on the public applicant list, this must be justified. Assessment will be made in accordance with current legislation. You will be notified if the reservation is not accepted.

If you have any questions about the position, please contact Lars Edvard Blystad Dæhli, email lars.e.dahli@ntnu.no. If you have any questions about the recruitment process, please contact Kristine Grønvold, e-mail: kristine.gronvold@ntnu.no.

If you think this looks interesting and in line with your qualifications, please submit your application electronically via jobbnorge.no with your CV, diplomas and certificates attached. Applications submitted elsewhere will not be considered. Upon request, you must be able to obtain certified copies of your documentation.

Application deadline: 16.06.2024

NTNU - knowledge for a better world

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The Norwegian University of Science and Technology (NTNU) creates knowledge for a better world and solutions that can change everyday life.

Department of Structural Engineering

We teach mechanical engineering, engineering and ICT, and civil and environmental engineering. The Department conducts internationally leading research and participates in several large national research projects. The Department of Structural Engineering is one of eight departments in the Faculty of Engineering.

Additional information

Place of service:

Høgskoleringen 1 7491 Trondheim (Trondheim Municipality)