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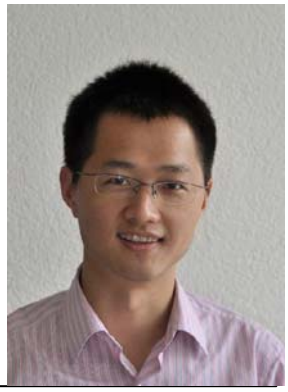

CAREER SUMMARY

Scientist in the laboratory for nuclear materials, Paul Scherrer Institute, Switzerland, focusing on structural integrity analysis, including fatigue and fracture assessments for reactor pressure vessel and piping, lifetime management of nuclear power plants

WORKING EXPERIENCE

1. 2013-present, Scientist in the **Laboratory for nuclear materials, Nuclear energy and safety department, Paul Scherrer Institute, Switzerland**

- As a research scientist, performing integrity analysis for nuclear structures and components by considering different ageing mechanisms, as well as providing expertise and consultant for nuclear authority and plants.

8. 2009-12. 2012, Postdoctoral fellow in the **Laboratory for nuclear materials, Nuclear energy and safety department, Paul Scherrer Institute, Switzerland**

- Conducted probabilistic analysis for nuclear components by considering different ageing mechanisms.

Journal Reviewer *for Nuclear Engineering and Design, Fatigue & Fracture of Engineering Materials & Structures, Corrosion Science, Steel Research International, Computation Materials Science, Engineering Failure Analysis, International Journal of Electrical Power and Energy Systems, Arabian Journal for Science and Engineering*

Guest researcher in the School of Mechanical and Power Engineering, East China University of Science and Technology, China, Shanghai

EDUCATION

2005.9－ 2009.6 **Institute of mechanics, Chinese Academy of Sciences**

- *Ph.D. in Solid Mechanics*

RESEARCH EXPERIENCE

Probabilistic fracture mechanics analysis for reactor pressure vessels, 2009-present

- A procedure and software are developed to perform probabilistic analysis for reactor pressure vessels subjected to pressurized thermal shocks by considering material irradiation embrittlement, flaw distribution and pressure and thermal stresses. Abaqus, FAVOR, VISA-II and PASCAL codes are used to perform fracture mechanics and probabilistic analyses, providing guidance for the lifetime extension of nuclear power plant.
- Finite element method (Ansys and Abaqus) is used to perform thermal stress analysis and stress intensity factor calculation due to the loss-of-coolant accidents. Statistical analysis of fracture

toughness is performed by Master Curve and ASME methods. Net-section collapse and ductile tearing analyses are performed.

- Failure frequency of a reactor pressure vessel is obtained. The data from the decommissioned plant in U.S. is used as input for the analyzed plant. Sensitivity analysis is conducted to investigate the important random variables affecting the vessel integrity. Surveillance data of the reactor pressure vessel is used for a more realistic analysis.
- Warm prestressing effect on the integrity of reactor pressure vessels is quantified by different micromechanical models.
- A method for the transferability of toughness from small specimens to the reactor pressure vessel is proposed. Effect of Crack tip constraint on fracture toughness of the material is described by two-parameter and three-parameter methods. The safety margin is quantified by considering constraint effect of surface crack.

Finite element modeling of brittle fracture for nuclear materials, 2012-present

- 2-D and 3-D finite element modeling of compact tension analyses are performed to study the crack tip distribution for different fracture toughness.
- A local approach model, which is both geometry and size independent, is used to analyze the size effect of specimen on fracture toughness of the material. The parameters of Beremin model are calibrated based on Master Curve method. The constraint effect is interpreted from a micro scale perspective.
- The lower bound of the fracture toughness in the ductile-to-brittle transition region is predicted. The fracture probability at different crack driving force is modelled.

Crack initiation and propagation in very-high-cycle fatigue, funded by National Natural Science Foundation of China, 2006-2009

- The Very-High-Cycle fatigue (VHCF) property of structural steel in air and environmental media (water and 3.5% NaCl solution) is comprehensively studied. The mechanism of VHCF and a corresponding model is proposed.
- S-N curves in different environmental media are obtained. In air, S-N curve of the high strength steel displays stepwise shape. In corrosive environment, S-N curves continuously descend. Fatigue strength decreases 99.5% in corrosive environment (3.5% NaCl) compared to that in air. It challenges traditional fatigue limit, providing a new design criterion for engineering structures in VHCF.
- Different crack initiation and propagation mechanisms in environmental media are clarified. Fatigue cracks always emerge from nonmetallic inclusions and forms a fisheye pattern in VHCF region. In air, crack propagates with transgranular cleavage pattern. While in environmental media it propagates along grain boundary. Stress intensity factor at fisheye is correspondent to the threshold of fracture toughness. The crack initiation in VHCF is mainly a process of small crack propagation and fatigue life is consumed mainly in the formation of fisheye pattern.
- A model based on dislocation deformation is proposed to account for the mechanism of fatigue initiation site transition in high cycle and VHCF regimes. It reflects the influence of grain size, yield stress, nonmetallic inclusion size, applied stress, environmental media on the crack initiation site. The model agrees well with the experimental observations.

Probabilistic failure analysis of pipeline and piping system according to FITNET FFS, 2009-present

- Probabilistic corrosion and fracture analyses for piping are conducted based on FITNET FFS, a European procedure for structural integrity analysis. It incorporated stress corrosion cracking, brittle fracture and plastic collapse analyses, using Monte Carlo simulation based on the failure assessment diagram.
- Correlated input random variables in the probabilistic analyses are taken into account by using Nataf transformation method. A computer code is developed by considering the correlated random variables. The effect of correlation coefficient of the involved variables, as well as the number of cracks on the failure probability of the piping is quantified.
- Stress intensity factor and plastic collapse loading of the piping are computed by ASME methods. The results achieved by deterministic and probabilistic analyses are compared.

SELECTED PUBLICATIONS

- Investigation of constraint and warm prestressing effects by means of a local approach to fracture. Engineering Fracture Mechanics 2015 (136) 26-37.
- Probabilistic pressurized thermal shocks analysis for a reactor pressure vessel. ASME Journal of Pressure Vessel Technology, 2015, doi: 10.1115/1.4030299.
- Calibration of Beremin model with the Master Curve. Engineering Fracture Mechanics 2015 (136) 15-25.
- Methodology and warm prestressing effect for pressurized thermal shock analysis in nuclear power plant. Applied Mechanics and Materials 2015 (750) 104-13.
- A model to predict S-N curves for surface and subsurface crack initiations in different environmental medias. International Journal of Fatigue, 2015 (71) 35-44.
- Investigation on constraint effect of a reactor pressure vessel subjected to pressurized thermal shocks. ASME Journal of Pressure Vessel Technology, 2015 (137) (011204-1)-(011204-7).
- Deterministic and probabilistic analysis of a reactor pressure vessel subjected to pressurized thermal shocks. Nuclear Engineering and Design, 2014 (273) 381-395.
- Probabilistic PTS analysis of a reactor pressure vessel by considering realistic crack distributions. Nuclear Engineering and Design, 2014 (270) 312-324.
- In-plane and out-of-plane constraint effects under pressurized thermal shocks. International Journal of Solids and Structures, 2014 (51) 1311-1321.
- Procedures, methods and computer codes for probabilistic assessment of reactor pressure vessels subjected to pressurized thermal shocks. Nuclear Engineering and Design, 2013 (258) 35-50.
- Integrity analysis of a reactor pressure vessel subjected to pressurized thermal shocks by considering constraint effect. Engineering Fracture Mechanics, 2013 (112-113) 14-25.
- Effect of correlated input parameters on the failure probability of pipelines with corrosion defects by using FITNET FFS procedure. International Journal of Pressure Vessel and Piping, 2013 (105-106) 19-27.
- Probabilistic leak-before-break analysis with correlated input parameters. Nuclear Engineering and Design, 2013 (254) 266-71.
- Experimental and theoretical investigation of environmental media on very-high-cycle fatigue behavior for a structural steel. Acta Materialia, 2011 (59) 1321-27.

- Probabilistic analysis of pipeline with corrosion defects by using FITNET FFS procedure. Corrosion Science, 2011 (53) 855-61.
- Probabilistic fracture assessment of piping systems based on FITNET FFS procedure. Nuclear Engineering and Design, 2011 (241) 714-22.
- Investigation of high cycle and very-high-cycle fatigue behaviors for a structural steel with smooth and notched specimens. Engineering Failure Analysis, 2010 (17) 1517-25.
- Effects of environmental media on high cycle and Very-High-Cycle fatigue behaviors of structural steel 40 Cr. Acta Metallurgica Sinica, 2009 (45) 1356-63.
- Integrity analysis of reactor pressure vessels subjected to pressurized thermal shocks by XFEM. Nuclear Engineering and Design, 2014 (275) 336-43.
- XFEM integrity analysis of quasi laminar flaws in a reactor pressure vessel subjected to pressurized thermal shocks. Nuclear Engineering and Design, 2014 (280) 464-72.
- Fatigue strength and crack initiation mechanism of Very-High-Cycle fatigue for low alloy steels. Metallurgical and Materials Transactions A, 2012 (8) 2753-62.
- Essential characteristics and influential factors for Very-High-Cycle fatigue behavior of metallic materials. Acta Metallurgica Sinica, 2009 (45) 769-80.
- Effect of aqueous environment on high cycle and Very-High-Cycle fatigue behavior for a structural steel. Key Engineering Materials, 2011 (462-463) 355-60.
- Fractography and crack initiation of Very-High-Cycle fatigue for a high carbon low alloy steel. Key Engineering Materials, 2006 (324-325) 1113-16.

CONFERENCES PROCEEDINGS

- Probabilistic pressurized thermal shocks analysis for a reactor pressure vessel by considering plume effect. 2015 ASME Pressure Vessel and Piping Division Conference, July 19-23, 2015, Boston, Massachusetts, USA. (Session chair, MF-25-1 Asian programs in structural integrity)
- Methodology and warm prestressing effect for pressurized thermal shock analysis in nuclear power plant, Proceedings of 2014 International Symposium on Structural Integrity, 49-58. 2014 International Symposium on Structural Integrity (invited keynote speaker), August 20-24, 2014, Lanzhou, China.
- Probabilistic pressurized thermal shocks analysis for a reactor pressure vessel. 2014 ASME Pressure Vessel and Piping Division Conference, July 20-24, 2014, Anaheim, California, USA.
- Constraint effects for a reactor pressure vessel subjected to pressurized thermal shock. 20th European Conference on Fracture (ECF20), June 30- July 4, Trondheim, Norway.
- Investigation on constraint effect of a reactor pressure vessel subjected to pressurized thermal shocks. 2013 ASME Pressure Vessel and Piping Division Conference, July 14-18, 2013, Paris, France.
- Crack propagation mechanism and life prediction for very-high-cycle fatigue of a structural steel in different environmental medias. Fracture and Structural Integrity, 2013 (25) 7-14. 2nd IJFatigue & FFEMS joint conference: characterization of crack tip stress fields. Malaga, Spain, April 15-17, 2013.
- Probabilistic assessment of pipelines containing corrosion defect with correlated input parameters based on FITNET FFS procedure. Proceedings of the 1st international conference of the international journal of structural integrity, 2012.

- Deterministic and probabilistic analysis of a reactor pressure vessel (RPV) subjected to pressurized thermal shocks (PTS). The Hague, the Netherlands, 5th International Conference on Engineering Failure Analysis, 2012.
- Investigation of high cycle and very-high-cycle fatigue behaviors for a structural steel with smooth and notched specimens. Dresden, Germany, 18th European conference on Fracture, Aug., 2010.
- Experiment and simulation of Very-High-Cycle fatigue behavior for low alloy steels. Proceedings of the12th international conference on fracture, 2009.
- Experimental investigation of Very-High-Cycle fatigue behavior for a structural steel. Advances in Heterogeneous Material Mechanics 2008, 1199-1202.
- Experimental Investigation of Very-High-Cycle Fatigue Behavior for a Structural Steel. 2rd International Conference on Heterogeneous Material Mechanics. Huangshan, China, Jun., 2008.
- Fractography and Crack Initiation of Very-High-Cycle Fatigue for a High Carbon Low Alloy Steel. International Conference of Fracture Damage Mechanics, Harbin, China, Sept., 2006.