Quantum Technologies AB

Technology based on knowledge

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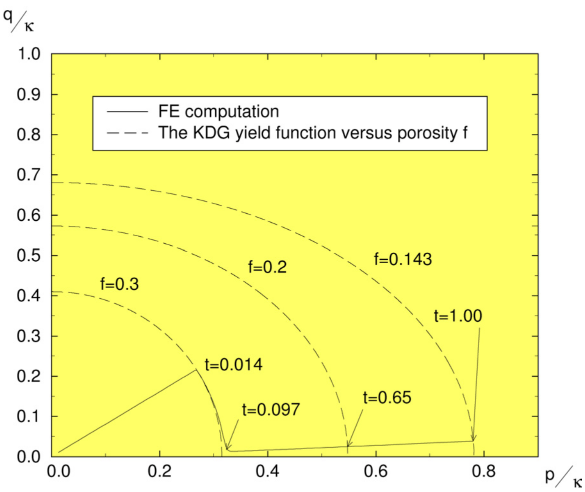
Quantum Technologies offers science-based consulting services in design, analysis, modeling and simulation of mechanical-material systems. We provide advanced technical services to power-, aerospace-, automotive- and processing industries. Our technologists have experience from research and development in both industry and academia and support a wide range of mechanical-material applications in the following fields of science:

- Mechanics and Physics of Solids
- Strength of Materials
- Fracture Mechanics and Material Damage
- Dynamics
- Computational Methods

Quantum Technologies is a customer-focused company with commitment to on-time, on-target delivery of results with optimum quality. Below we briefly describe our industry.

Mechanics and Physics of Solids

Quantum Technologies has long experience in analyses and simulations of the thermo-mechanical behavior of solid materials, such as metals, ceramics, polymers, cellular and granular solids and composites. We develop constitutive relations for these materials at both ambient and elevated temperatures. We also model various detrimental processes in solids and analyze the effects of e.g. irradiation or corrosion on material behavior and integrity. We have a good knowledge of thermodynamics of material systems, electrodynamics of continuous media, and multi-field analyses. We carry out computer simulations of physical processes in solid materials, and are familiar with Monte Carlo techniques, molecular dynamics, and quantum mechanical methods.



Modeling of consolidation process of granular materials under compressive stresses. Al_2O_3 powder confined in a steel cylinder and subjected to compressible hydrostatic pressure. The solid curve shows the evolution of the equivalent stress q versus the hydrostatic pressure p during densification. Here, κ is the flow stress of the material and f the porosity fraction. The yield criterion used for the Al_2O_3 powder is pressure-dependent, and obeying the Kuhn-Green-Downey relation.

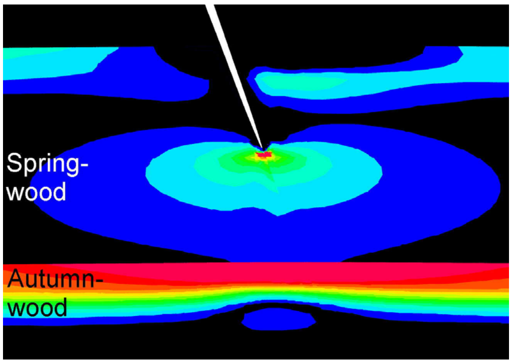
Strength of Materials

We carry out mechanical analyses of structural elements subject to thermal and/or mechanical loads. More specifically, we conduct stress and deformation analyses, including structural instability of hyperelastic, visco-elastic-plastic materials and also model contact-impact problems. Moreover, we perform advanced thermal-mechanical analyses in the field of nuclear fuel technology. We mainly carry out our evaluations by using linear and/or nonlinear finite element (FE) methods, but we also employ other numerical approaches as well as analytical methods.

Fracture Mechanics and Material Damage

We model and analyze material damage, fretting wear, crack initiation and propagation in a wide range of materials. Our technical staff carries out complete evaluations of fracture and other type of material failures in machinery components and structures. Our analysis capabilities encompass the following problem areas:

- Evaluation of environment-induced damage and fracture of materials, such as crack propagation under stress corrosion conditions and hydrogen-induced embrittlement in both hydride- and non-hydride forming metals.
- Evaluation of fracture in cellular and fibrous materials such as composites, paper and wood.
- Evaluation according to the ASME Boiler Pressure Vessel Code. Rules for calculation of allowable flaw sizes based on linear and nonlinear fracture mechanics principles.
- Methods for calculation of various measures for stress intensities in pressure vessels. Evaluation according to the CTOD design curve of the British Standard document PD 6493 or BS 7910.
- Fracture mechanics analyses of cracks in piping systems, e.g. stress corrosion cracking under normal operating and postulated accident conditions and analyses of "leak-before-break" conditions.

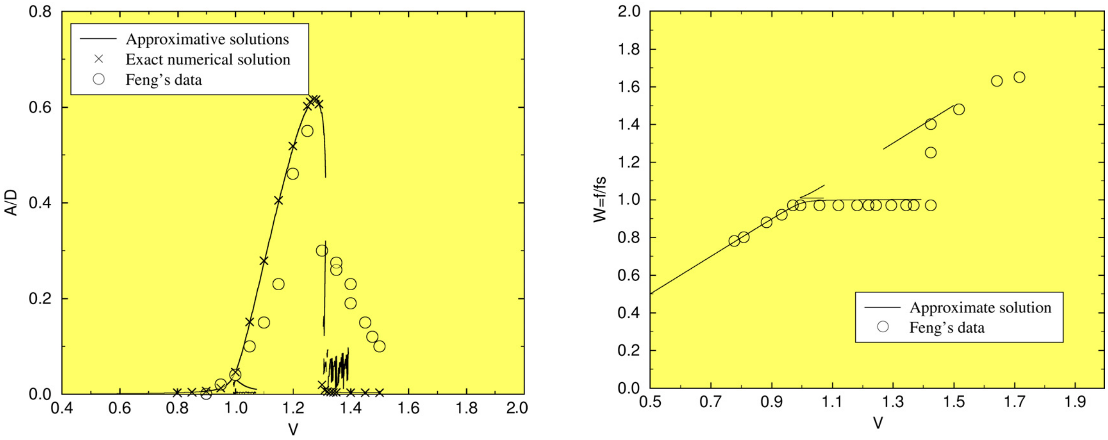


Modeling of crack growth in wood. The plot shows the near-tip stress field at a crack in Scots pine. The crack is growing with a slight inclination to the radial direction in the tree trunk, and the tip is located in the soft springwood part of a growth ring. The highly stressed bands ahead and astern of the crack tip correspond to autumnwood, which is characterized by high stiffness and density.

Dynamics: Vibration & Seismic Analyses

We carry out complete analyses of vibration and impact problems in machinery components. Our technologists perform both linear and nonlinear time history analyses (modal superposition, complex frequency response, direct integration) and response spectrum analyses. Based on many years of research and development, we have a good knowledge of state-of-the-art computational methods in linear and nonlinear vibrations.

Our experience comprises flow-induced vibrations (FIV), electromagnetic field induced vibrations (EFIV) and seismic analysis. In the FIV area, we are positively familiar with problems of turbulent (random) excitations, fluid-elastic instabilities, galloping and flutter, and vortex-induced vibrations of tubular structures. In EFIV, we have experience with analysis of the end winding of electrical machines. In the area of seismic structural analysis, we have ample experience on computations of the Safe Shutdown Earthquake (SSE) and the Operating Basis Earthquake (OBE) concepts. We are familiar with mechanical design standards for nuclear power plants, ASME III, Appendix F (USA) and KTA 2201.4 (Germany). In structural design analysis of equipment used in transmission and distribution of electrical power, we are acquainted with the civil engineering standard, ASCE 7-95 (USA).



Vortex-induced vibration of a tube. (a) Reduced amplitude A/D versus reduced vortex shedding frequency $V=\omega_s/\omega_n$. (b) Reduced frequency versus $V=\omega_s/\omega_n$. Measured data are extracted from Feng's experiment. Here, D is the tube diameter and ω_n its natural frequency.

Computational Methods and Software

We develop, maintain, and evaluate computer programs in mechanical engineering sciences. For example, we have developed tools for complete design analyses of nuclear reactor fuel systems. We follow quality standards in software development (ISO-9001-3) and utilize several scientific programming languages, such as Fortran-90 and C. We also have programming experience in various parallel computing environments, such as MPI and Open MP. Moreover, we have performed many FE analyses in research and engineering design, using commercial computational tools, such as ANSYS, ADINA, and ABAQUS.

Education and Training

We offer workshops, courses and seminars in all of the foregoing topics. Our staff has teaching experience at the university level, and our courses are tailor-cut to meet requirements from the client. The training can be given at the client's premises or elsewhere.

If you wish to know more about our services, feel free to contact us at
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