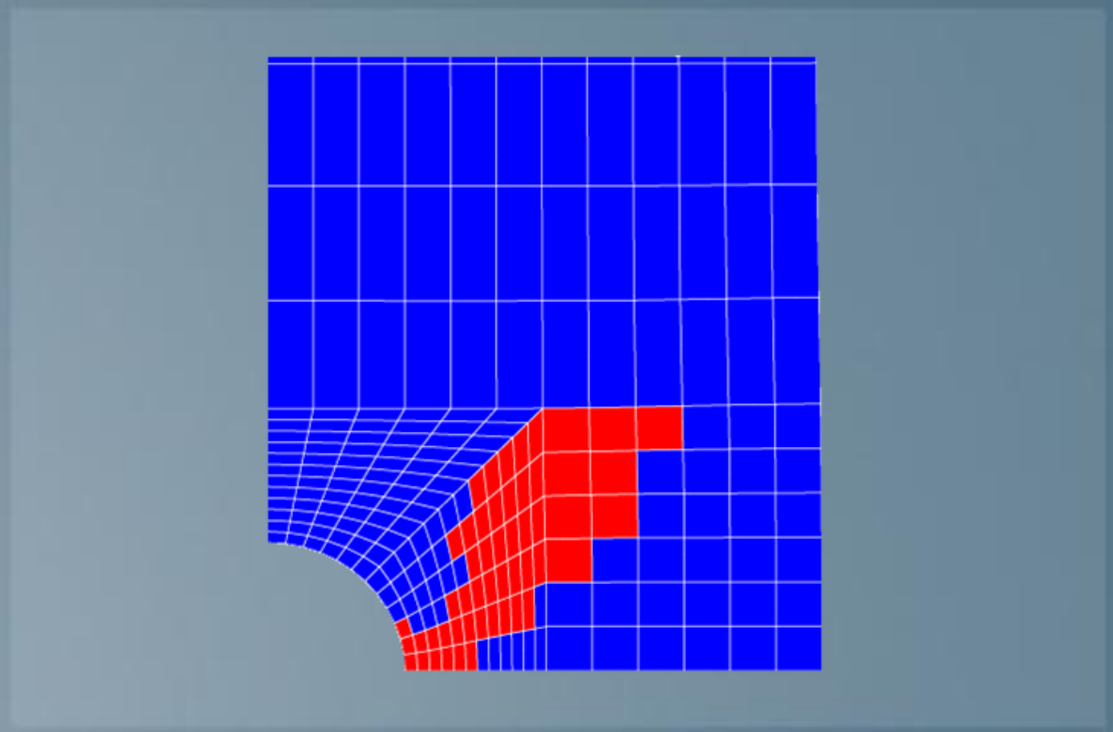
Writing User Subroutines with Abaqus

6.14



About this Course

Course objectives

In this course you will learn about:

- When and how to use subroutines
- DLOAD, VDLOAD, and UTRACLOAD for specifying user-defined loading
- FILM for specifying user-defined film conditions
- USDFLD and VUSDFLD for defining field variable dependence
- URDFIL for reading the results file during analyses
- UVARM for defining a user output variable
- UMAT and VUMAT for allowing constitutive models to be added to the program
- UEL and VUEL for allowing the creation of user-defined elements

Targeted audience

This course is recommended for engineers with experience using Abaqus.

Prerequisites

A working knowledge of the finite element method and programming in either Fortran or C

Day 1

- Lecture 1 Introduction
- Lecture 2 User Subroutines (V)DLOAD and UTRACLOAD
- Lecture 3 User Subroutine FILM
- Workshop 1 User Subroutine FILM
- Lecture 4 User Subroutine (V)USDFLD
- Lecture 5 User Subroutine URDFIL

Day 2

- Lecture 6 User Subroutine UVARM
- Lecture 7 Writing a UMAT or VUMAT
- Workshop 2 User Subroutine UMAT: Tangent Stiffness
- Lecture 8 Creating a Nonlinear User Element (UEL and VUEL)

Additional Material

- Appendix 1 Logical Modeling in Abaqus
- Workshop 3 Controlling an Inverted Pendulum with VUAMP
- Appendix 2 Running User Subroutines in Parallel

Join the Community!

How can you maximize the robust technology of Abaqus FEA and Isight?

Connect with peers to share knowledge and get technical insights

SIMULIA

Let the SIMULIA Learning Community be *Your* Portal to 21st Century Innovation

Discover new ways to explore how to leverage realistic simulation to drive product innovation. Join the thousands of Abaqus and Isight users who are already gaining valuable knowledge from the SIMULIA Learning Community.

For more information and registration, visit **3ds.com/simulia-learning**.
Connect. Share. Spark Innovation.

DASSAULT SYSTEMES | The **3D**EXPERIENCE Company

©2013 Dassault Systèmes. All rights reserved.

Legal Notices

The Abaqus Software described in this documentation is available only under license from Dassault Systèmes or its subsidiary and may be used or reproduced only in accordance with the terms of such license.

This documentation and the software described in this documentation are subject to change without prior notice.

Dassault Systèmes and its subsidiaries shall not be responsible for the consequences of any errors or omissions that may appear in this documentation.

No part of this documentation may be reproduced or distributed in any form without prior written permission of Dassault Systèmes or its subsidiary.

© Dassault Systèmes, 2014

Printed in the United States of America.

Abaqus, the 3DS logo, SIMULIA, and CATIA are trademarks or registered trademarks of Dassault Systèmes or its subsidiaries in the US and/or other countries.

Other company, product, and service names may be trademarks or service marks of their respective owners. For additional information concerning trademarks, copyrights, and licenses, see the Legal Notices in the Abaqus 6.14 Installation and Licensing Guide.

Revision Status

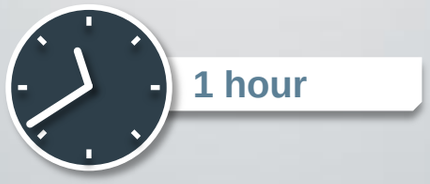
Lecture 1	5/14	Updated for 6.14
Lecture 2	5/14	Updated for 6.14
Lecture 3	5/14	Updated for 6.14
Lecture 4	5/14	Updated for 6.14
Lecture 5	5/14	Updated for 6.14
Lecture 6	5/14	Updated for 6.14
Lecture 7	5/14	Updated for 6.14
Lecture 8	5/14	Updated for 6.14
Appendix 1	5/14	Updated for 6.14
Appendix 2	5/14	Updated for 6.14
Workshop 1	5/14	Updated for 6.14
Workshop 2	5/14	Updated for 6.14
Workshop 3	5/14	Updated for 6.14

Lesson 1: Introduction

Lesson content:

- Overview of Some User Subroutines
- Where User Subroutines Fit into Abaqus/Standard
- Including User Subroutines in a Model
- Writing Output from User Subroutines
- Compiling and Linking User Subroutines
- Debugging Techniques and Proper Programming Habits
- C/C++ interface
- Support for User Subroutines

www.3ds.com | © Dassault Systèmes



Lesson 2: User Subroutines (V)DLOAD and UTRACLOAD

Lesson content:

- Introduction
- Abaqus Usage
- DLOAD Subroutine Interface
- Example: Viscoelastic Cylinder
- Example: Asymmetric Pressure Loads
- VDLOAD Subroutine Interface
- Example: Viscoelastic Cylinder Revisited
- UTRACLOAD Subroutine Interface
- Example: Flexure of a Cantilever Beam

www.3ds.com | © Dassault Systèmes

1 hour

Lesson 3: User Subroutine FILM

Lesson content:

- Introduction
- Abaqus Usage
- FILM Subroutine Interface
- Example: Radiation in Finned Surface
- Workshop Preliminaries
- Workshop 1: User Subroutine FILM (IA)
- Workshop 1: User Subroutine FILM (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.

75 minutes

www.3ds.com | © Dassault Systèmes

Lesson 4: User Subroutine (V)USDFLD

Lesson content:

- Introduction
- Abaqus Usage
- Utility Routine GETVRM
- USDFLD Subroutine Interface
- Example: Laminated Composite Plate Failure
- Utility Routine VGETVRM
- VUSDFLD Subroutine Interface
- Example: Laminated Composite Plate Failure Revisited

www.3ds.com | © Dassault Systèmes

2 hours

Lesson 5: User Subroutine URDFIL

Lesson content:

- Introduction
- Abaqus Usage
- URDFIL Subroutine Interface
- Example: Using URDFIL to Terminate an Analysis

www.3ds.com | © Dassault Systèmes

30 minutes

Lesson 6: User Subroutine UVARM

Lesson content:

- Introduction
- Abaqus Usage
- UVARM Subroutine Interface
- Example: Calculation of Stress Relative to Shift Tensor
- Creating Contour Plots for UELs

www.3ds.com | © Dassault Systèmes

30 minutes

Lesson 7: Writing a UMAT or VUMAT

Lesson content:

- Overview
- Motivation
- Steps Required in Writing a UMAT or VUMAT
- UMAT Interface
- Example 1: UMAT for Isotropic Isothermal Elasticity
- Example 2: UMAT for Non-Isothermal Elasticity
- Example 3: UMAT for Neo-Hookean Hyperelasticity
- Example 4: UMAT for Kinematic Hardening Plasticity
- Example 5: UMAT for Isotropic Hardening Plasticity
- VUMAT Interface
- Example 6: VUMAT for Isotropic Isothermal Elasticity
- Example 7: VUMAT for Neo-Hookean Hyperelasticity
- Example 8: VUMAT for Kinematic Hardening Plasticity
- Example 9: VUMAT for Isotropic Hardening Plasticity
- Workshop 2: User Subroutine UMAT: Tangent Stiffness (IA)
- Workshop 2: User Subroutine UMAT: Tangent Stiffness (KW)

3 hours

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.

www.3ds.com | © Dassault Systèmes

Lesson 8: Creating a Nonlinear User Element

Lesson content:

- Overview
- Motivation
- Defining a User Element in Abaqus/Standard
- UEL Interface
- Example 1: Planar Beam Element with Nonlinear Section Behavior
- Example 2: Force Control Element
- Example 3: Plane Strain Element
- UELMAT Interface
- Using Nonlinear User Elements in Various Analysis Procedures
- Defining a User Element in Abaqus/Explicit
- VUEL Interface
- Example 4: Three-Dimensional Truss Element

3 hours

www.3ds.com | © Dassault Systèmes

Appendix 1: Logical Modeling in Abaqus

Appendix content:

- Introduction
- Defining Logical Modeling
- Example: Force Control
- Workshop 3: Controlling an Inverted Pendulum with VUAMP (IA)
- Workshop 3: Controlling an Inverted Pendulum with VUAMP (KW)

Both interactive (IA) and keywords (KW) versions of the workshop are provided. Complete only one.

1.5 hours

www.3ds.com | © Dassault Systèmes

Appendix 2: Running User Subroutines in Parallel

Appendix content:

- Thread Parallel Support
- MPI Parallel Support
- Dynamic Allocation of Memory and Access on Demand
- Example: Array Creation
- Example: Array Usage
- Guidance

www.3ds.com | © Dassault Systèmes