Investigation of direction- and age-dependent prestretch in murine cranial dura mater
Jack Consolini
Updated: 2023/05/31

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Preface

This document explains how to create the ⅛ ellipsoid geometries used within Consolini et al. 2023. The *ICRMouseDuraMaterModels.py* develop the model, which then we can take the input files, and then run the UMAT subroutine to simulate stretching. Then *ICRMouseDuraMaterResults.py* is used to extract the incision opening ratio.

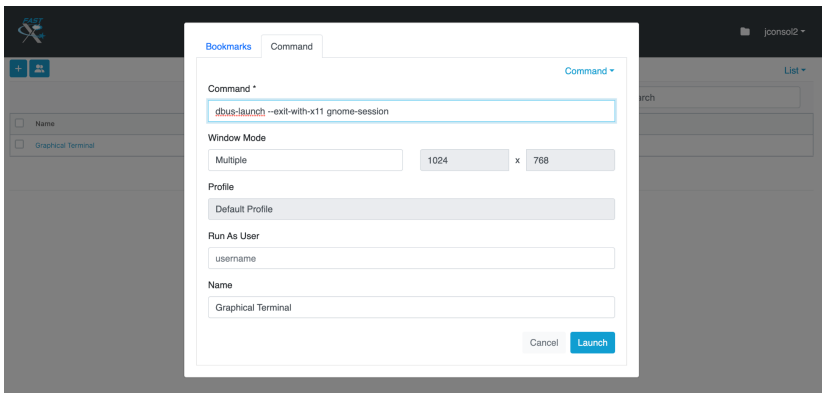
How to run Abaqus-python scripts:

Script name: *ICRMouseDuraMaterModels.py*

- This script uses Abaqus's built in computer-aided design capabilities to efficiently create the neonatal and adult mouse models. This script can be modified to create the models within the curvature analysis.
- To run the script:

*Make sure you are on the *eduroam* wifi network or signed into the Notre Dame VPN*

1. Go to ***commandfe.crc.nd.edu*** and sign in with your credentials
2. Start a new gnome session:



3. Within the new session, open your Linux terminal, go to the folder you want to work in, and open the Abaqus GUI

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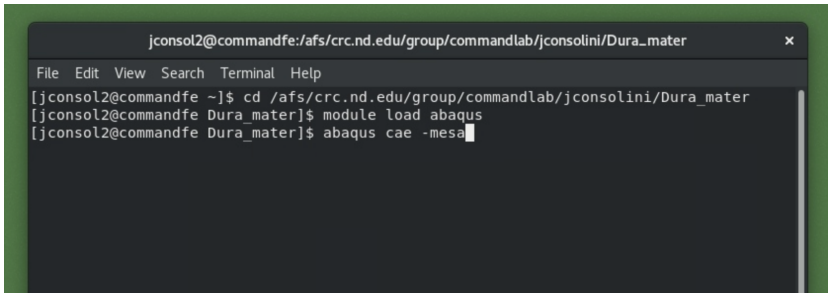
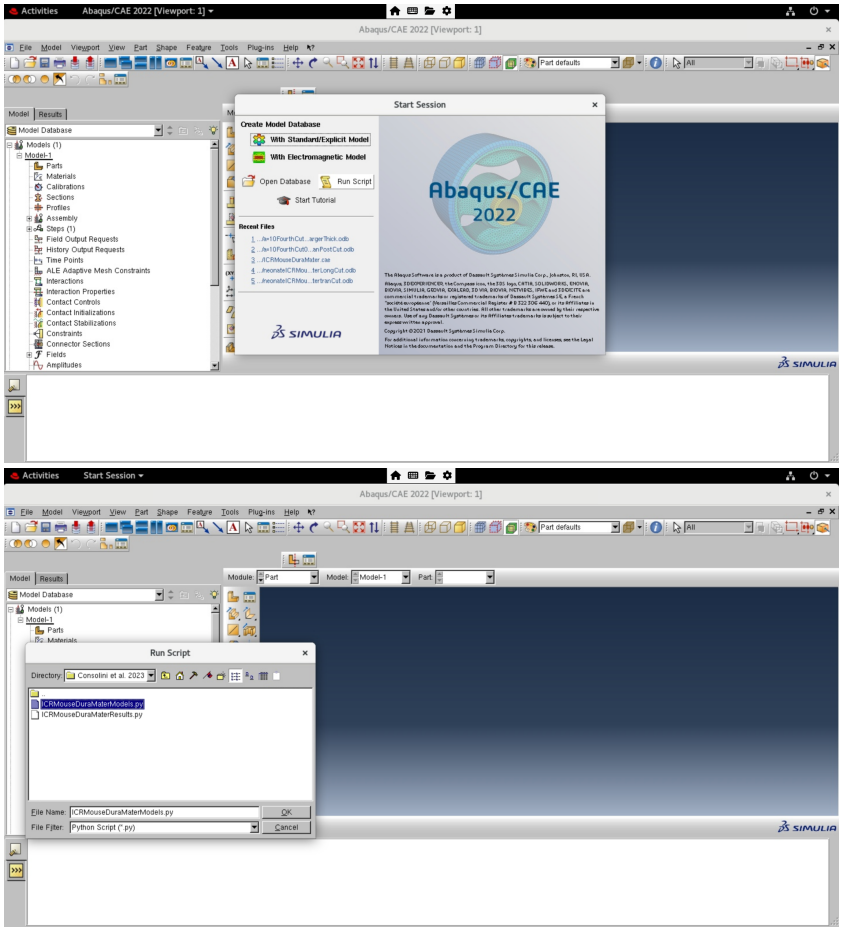


4. Select to run script when prompted:



5. The models for the neonate and adult with transverse and longitudinal cuts should be automatically created. The reason I chose to have you run this in the GUI is so that the user can look at the models and make sure they are correct.

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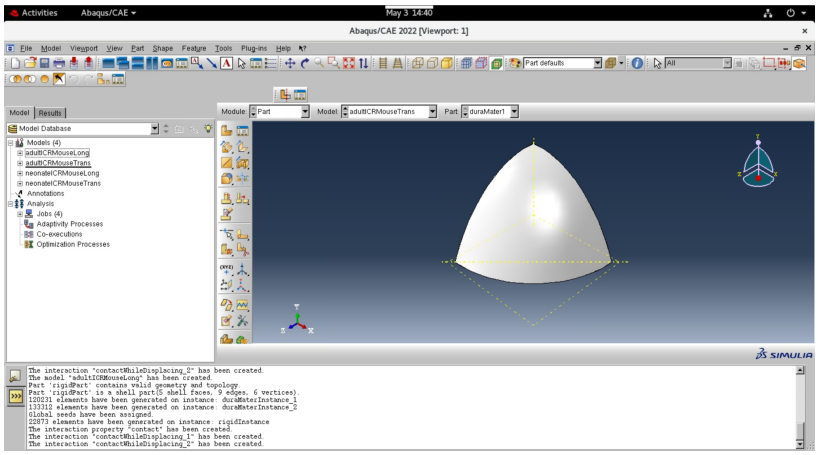

Script name: *ICRMouseDuraMaterResults.py*

- This script extracts the incision opening width and length information, along with the nodes that they are being calculated from, from all models created within this paper.
- To run the script:

*Make sure you are on the *eduroam* wifi network or signed into the Notre Dame VPN, and make sure that your .odb file you are taking the data from is within the same folder as this script.*

1. Login to ***commandfe*** via your terminal:

2. Once logged in, go to the folder you want to work in, initialize Abaqus-python environment, and run script

3. You will then see the script automatically extract the info to .csv files. The code tells you what frame of the .odb it is on, so you can keep track of progress if it is to fail.

How to run UMAT subroutine w/ input files:

Script name: *umat_transverseIsotropicStretch.f*

- This Fortran subroutine applies isotropic stretching along the surface of the ⅛ ellipsoid models. The isotropic stretching occurs transverse to the surface of the model.
- To apply this subroutine to the input files:

*Make sure you are on the *eduroam* wifi network or signed into the Notre Dame VPN, and make sure that the .inp file and UMAT subroutine are within the same folder*

1. Login to ***commandfe*** via your terminal:

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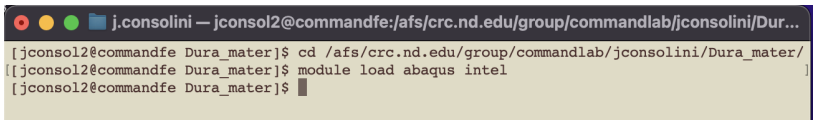
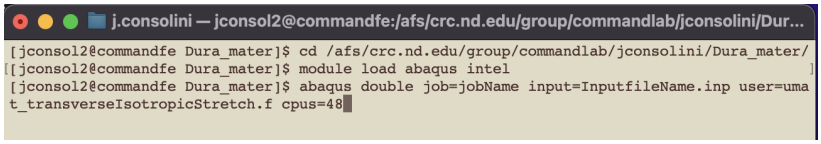
2. Once logged in, go to the folder you want to work in, initialize Abaqus intel environment:



3. Name your job, select the input, and submit for running.

NOTE: use cpus=48 to speed up the simulation



4. It will run in the background, but you will not be able to run other jobs while this runs (if you use cpus-48)

Input file list:

1. Neonate and adult models:
   - *neonateICRMouseDuraMaterTranCut.inp*
   - *neonateICRMouseDuraMaterLongCut.inp*
   - *adultICRMouseDuraMaterTranCut.inp*
   - *adultICRMouseDuraMaterLongCut.inp*
2. Curvature vs. incision opening ratio models:
   - *adultICRMouseDuraMaterTranCutHalfAxis.inp*
   - *adultICRMouseDuraMaterTranCut4thAxis.inp*
   - *adultICRMouseDuraMaterTranCut8thAxis.inp*
   - *adultICRMouseDuraMaterTranCut16thAxis.inp*
   - *adultICRMouseDuraMaterLongCutHalfAxis.inp*
   - *adultICRMouseDuraMaterLongCut4thAxis.inp*
   - *adultICRMouseDuraMaterLongCut8thAxis.inp*
   - *adultICRMouseDuraMaterLongCut16thAxis.inp*
3. Cut length vs incision opening ratio models:
   - *a=2MouseDuraMaterTranCut.inp*
   - *a=4MouseDuraMaterTranCut.inp*
   - *a=6MouseDuraMaterTranCut.inp*
   - *a=8MouseDuraMaterTranCut.inp*
   - *a=10MouseDuraMaterTranCut.inp*
   - *a=2MouseDuraMaterLongCut.inp*
   - *a=4MouseDuraMaterLongCut.inp*
   - *a=6MouseDuraMaterLongCut.inp*
   - *a=8MouseDuraMaterLongCut.inp*
   - *a=10MouseDuraMaterLongCut.inp*

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Additional notes:

For any additional questions please contact Jack Consolini at personal email: *jconsolini2@gmail.com*