ADORE Update Version 7.20

Limited Release Date: January 18, 2018

ADORE 7.20 is part of continued enhancement of life and elastohydrodynamic traction models in ADORE. This update incorporates the enhanced version of the shear-thinning traction model for 23699 type lubricant. In addition, a minor correction to the code, identified after release of version 7.10 has been implemented in the updated version. The following is a description of all updates:

1. Code Corrections

During the test phase of version 7.10 a statement (line 151) in subroutine Adrf2 was added to bypass the lubricant churning effects on cage. However, this statement was not removed from the final version 7.10. It is important to delete this statement. The following partial code listing of subroutine adrf2.f shows the required correction:

```
…
…
!-------------------------------------------
!     initialize solutions
!     --------------------
      dragF=zero
                ! zero->Constants
      chrnMc=zero
      chrnMe=zero
      if (orbV == zero) return  <<<<------- Delete this
line            ! no churning computation at zero speed
      if (kChrnProp == 0) then
!-------------------------------------------
!        setup churning viscosity and density at
….

…
```

2. Code Enhancements

The shear-thinning elastohydrodynanic traction model has been completely rewritten to implement substantially improved thermal interactions in the lubricant film. The updated code now solves the energy equation through the film to compute temperature distribution. The procedure requires integration of a differential equation through the film for each incremental element in the rolling element to race contact. Hence the updated procedure is more compute intensive. However, in view of fairly efficient integrating algorithms in ADORE and reasonably fast compute speed of current processers, the overall impact on code performance is expected to minimum. The enhancement does result in improved treatment of thermal effects in the lubricant film, thereby providing improved traction computation. In comparison to the simplified treatment in version 7.10

the enhanced code provides a slightly higher traction coefficient. This is a due to a small reduction in lubricant film temperature.

For the visco-elastic model, the simplified iterative procedure introduced in version 7.0 remains unchanged. However, in view of the greatly simplified assumptions in this treatment, the convergence criterion has been somewhat relaxed do reduce the computing effort. At conditions when thermal effects are significantly large, such as those at very high contact pressures or at high slide-to-roll ratios, there are still some convergence problems. For this reason a new option to bypass the thermal effects in visco-elastic models has been introduced on input Record 10.0. The objective here is to at least provide a solution by completely eliminating the thermal effects in the visco-elastic traction model.

The enhancement also includes pressure dependent cryogenic churning media properties; the affected fluids are LOX, LH2 and LN2. This enhancement required addition of new subroutines Adrg51 and Adrg52 for two-dimensional linear interpolation of data. While Adrg51 performs a simple linear interpolation, Adrg52 carries out a linear interpolation on a semi-log scale, as required in the viscosity-pressure-temperature data.

3. ADORE User Manual

There are no updates to the ADORE user manual in this update. However, in view of the additional input data requirements, the input facility has been updated, as discussed below.

4. ADORE Input Facility, AdrInput

The input facility AdrInput has been modified to provide newly required input data. Note that older data sets may not work with ADORE version 7.20. However, the old input data sets may be opened with new AdrInput facility to convert the data files for use with ADORE 7.20

5. ADORE Plot Facility, AdrPlot

There are no modifications to the plot facility Adrplot in this version.

6. ADORE Animation Facility, AGORE

There are no modifications to the animation facility (AGORE).

7. Test Cases

As usual the input data, print output and all plot data sets are included in the test cases subdirectories in the program media. These examples must be run and checked after installation of the program. All outputs, at least at step 0, must match against the supplied output.

8. Program File Contents:

Program updates are distributed on a CD in normal data format. The files may be easily extracted from this disk on any computer system and then transferred to appropriate system for which ADORE is licensed for.

The media contains the following three subdirectories and a **readMe.pdf** file, which provides latest update information and instructions for quick installation on the Windows machine:

Disk1

Update720.pdf: A pdf file containing notes of the latest updates (this file).

Update710.pdf: This pdf file from version 7.10 is retained for this distribution.

adoreInput.txt: A text file containing details of ADORE input data.

adoreManual.pdf: ADORE user's manual.

Ball: Subdirectory containing ball bearing test case.

Roller: Subdirectory containing roller bearing test case.

TaperedRoller: Subdirectory containing tapered roller bearing test case.

AdrxExamples: Subdirectory containing few of the user programmable examples.

Disk2

***.f files:** ADORE FORTRAN-90/95 source files.

makeIntel.txt: Makefile for Windows 7 machine with Intel Fortran compiler.

makeLahey.txt: Makefile for Windows 7 machine with Lahey Fortran compiler.

makeUnix.txt: Makefile for Intel compiler on a Unix operating system.

Disk3

setup.bat: Setup batch file to compile adrInput, adrPlot and AGORE on Windows system.

adrInput.bat: Batch file to execute adrInput.

adrPlot.bat: Batch file to execute adrPlot.

agore.bat: Batch file to execute the graphics animation facility, AGORE.

Java: Subdirectory containing all Java source files.

9. Program Installation

Quick installation steps are outlined in the readMe.txt file supplied on the program disk. More detailed installation instructions are included in the users manual.

9.1 ADORE Installation

Make files are provided in Disk2 directory for easy installation of ADORE for both the Intel and Lahey compilers for a Windows machine. The nmake command available with these compilers may be used to compile and create an executable code. In addition a make file is also included for a Unix operating system, running an Intel FORTRAN compiler. This file may also be used on a Macintosh computer, since Mac OS is essentially based on Unix.

In case of other computing platforms and/or operating systems, any of the supplied make file may be appropriately edited and used for ADORE installation.

9.2 Installation of Java facilities adrInput, adrPlot and Agore

Edit the setup.bat file in Disk3 subdirectory to correct the paths to all source files and the Java Development Kit. Execute the updated setup file to compile and generate executables for these facilities.

The executable files for the three applications may then be transferred to appropriate run directory, an access to which may be defined by the environmental variable on the applicable computer system.

10. Contact Information

In the event of any questions and/or technical support please contact:

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