ADORE Update Version 9.20

Release Date: March 11, 2024

Adore 9.20 provides a minor update to version 9.10. The primary emphasis is on geometrical imperfections in cylindrical and tapered roller bearing. Also, all temporary fixes issued after release to version 9.10 are now permanent.

1. Code Enhancements

In roller bearings with line contact configuration for roller to race interaction, integration over the contact zone to compute the total load support is carried out numerically by segmenting the contact zone in discrete slices, the width of which is defined by the quadrature formula used to perform the integration. Thus, depending on the extent of interaction and the input geometry there may be a significant variation in width of the slices. Obviously, any geometrical imperfections further complicate the problem.

Unlike ball bearings where the ball only interacts with the races via a well-defined elliptical point contact, the rollers, in addition to interaction with races, also interact with guide flanges. While the flange contacts in cylindrical roller bearings are only significant when the roller is subject to misalignment and/or skew, roller end to flange interaction is always critical in tapered roller bearing. Therefore, both the roller and flange geometries are significant in modeling roller interactions.

Since ADORE architecture is based on generalized vector operations analytical capabilities to model arbitrary geometrical imperfections on all elements of the bearing have always been included in the analytical formulations. However, in order to reduce the required computational effort certain restrictions were imposed, particularly in tapered roller bearings. These restrictions are now removed in this release of ADORE, since with the continually advancing computational technologies, computing effort is no longer a major problem.

Although for most applications this update does not bring any new capabilities, some minor numerical differences in may be seen particularly in tapered roller bearings, where the roller always experiences very minor misalignment and skew due to gyroscopic moment on the roller, which becomes significant at high speeds. The flange geometries both in cylindrical and tapered roller bearings have been refined and all geometrical imperfections are now available in both cylindrical and tapered roller bearings.

When comparing the test cases with earlier versions, some minor differences in cylindrical roller bearing are due to refined tolerances on equilibrium equations. The differences in tapered roller bearing runs are due to geometrical enhancements in flange origin definition. While the ball bearing solutions at step zero are identical to those produced with version 9.10, there are significant difference in the step 100 solution. This difference in traced back to incorrect cage/race land specification in the ball bearing data file supplied with several earlier versions; both lands were incorrectly specified on positive x-axis. This is corrected in the current ball bearing input data file supplied with version 9.20. This obviously alters the cage dynamics; hence the difference in step 100 solution.

2. ADORE User Manual

The resulting modifications in the input data records have not yet been implemented in the user manual, which will be updated at the time of next major release. For accurate preparation of input data please refer to the input facility, AdrInput, as discussed below.

3. ADORE Input Facility, AdrInput

The input facility, **AdrInput**, has been updated to include all changes in the input data as discussed above. As usual, please open any old data set with the updated AdrInput and examine each data record carefully. The output data file will conform to the current format.

4. ADORE Plot Facility, AdrPlot

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

5. ADORE Animation Facility, AGORE

There are no updates to **AGORE** in this version.

6. Test Cases

As usual the input data, print output and all plot data sets are included in the test cases subdirectories in the program folder. 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.

7. Program File Contents:

The program media supplied electronically in the media file **Adore910.zip** contains the following four subdirectories and a **readMe.pdf** file, which provides latest update information and instructions for quick installation on the Windows and Macintosh machines:

Disk1

Update920.pdf: A pdf file containing notes on the latest updates (this file).

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 cylindrical 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: Make file for Windows machine with Intel Fortran compiler.

makeLahey.txt: Make file for Windows machine with Lahey Fortran compiler.

makeUnix.txt: Make file for Intel compiler on a Unix and/or Macintosh system.

Disk3

Java: Subdirectory containing all Java source files.

Disk4

For convenience, this subdirectory contains immediately usable executable files for both Windows and Macintosh operating systems. Of course, all executables may be created by compiling the source codes supplied in Disk2 and Disk3 directories. The contents of Disk4 directory are as follows:

Windows: Windows subdirectory

Adore920.exe:	**ADORE** executable
AdrInput.jar:	**AdrInput** (Java executable)
AdrPlot.jar:	**AdrPlot** (Java executable)
Agore.jar:	**AGORE** (Java executable)

Mac: Macintosh subdirectory

Adore920:	**ADORE** executable (Unix executable for Mac)
AdrInput.jar:	**AdrInput** (Java executable)
AdrPlot.jar:	**AdrPlot** (Java executable)
Agore.jar:	**AGORE** (Java executable)

While ADORE is a command line application and it must be executed on a command line in appropriate directory containing the input data file DATA.txt, the java applications may be executed by a simple double click on the application icon. On command line the application may be executed by invoking the following command:

java -jar *jarFileName*

where *jarFileName* may be **AdrInput.jar**, **AdrPlot.jar** or **Agore.jar**. Of course, the path for the jar file must be satisfied.

8. Program Installation

Quick installation steps are outlined in the **readMe.pdf** file supplied in the program file. More detailed installation instructions are included in the user's manual.

8.1 ADORE Installation

Make files are provided in Disk2 directory for easy installation of ADORE for both the Intel and Lahey compilers on 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 based on Unix.

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

8.2 Installation of Java facilities AdrInput, AdrPlot and Agore

The freely available **Netbeans 8.2** Java Development IDE is used to create the java executable jar files as supplied in the Disk4 directory. This eliminates the more complicated

command line procedures used in all earlier versions of ADORE. **Netbeans 8.2** may be freely downloaded from Oracle website. This requires **Java 1.8** Java Development Kit, which is also available from Oracle website. The Java JDK must be installed before installing Netbeans.

The jar files so created with **Netbeans 8.2** are self-contained and do not require specification of any classpath statements. Also, since most Java applications are platform independent, the jar files may be used on both Windows and Macintosh operating system. In fact, the jar files supplied in the Disk4 directory under the Windows and Macintosh subdirectories are identical.

Please see the user manual or the **readMe.pdf** file for more details on using **Netbeans 8.2** for compiling the java applications.

9. Contact Information

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

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