ADORE Update Version 5.60
Release Date: August 31, 2011

ADORE 5.60 is an enhancement to earlier version 5.50. All temporary fixes issued as versions 5.51, 5.52, 5.53 and 5.54 are now permanent in version 5.60. The following is a description of specific enhancements and error fixes:

Code Enhancements

Equilibrium equations for roller bearings with misalignment

In several previous versions of ADORE the amount of race misalignment over which the equilibrium solutions could be successfully obtained had a significant limitation particularly with line contacts at the roller to race interface. With increasing misalignment since both the contact length and loads change the numerical quadrature scheme gets redefined from one iteration to the other. This results in some inaccuracies in computation of the various terms in the Jacobian matrix used in the Newton-Raphson iterative procedure, particularly for the rollers which are either entering or exiting the load zone. As a result the iterations have difficulty in converging. In order to help solve this problem a new numerical procedure has been implemented there the squared deviation of the residual load vector is minimized. This procedure does provide an acceptable solution when Newton-Raphson iterations do not converge. The option for using this new procedure is turned on by a new option flag, kReEqCode, on input record 3.3. This optional procedure is of course used only when the classical Newton-Raphson procedure does not converge. Hopefully, this procedure will help modeling misalignment in roller bearings until further improvements in numerical procedures related to the solution of equilibrium equations in roller bearings.

In addition to the above, the procedure for applying geometrical constraints on the unloaded rollers are refined to maintain roller and race alignment at the outer race contact when the outer race is subjected to misalignment. This greatly helps in obtaining convergence on the equilibrium equations for the unloaded rollers.

Traction modeling

In the area of traction modeling this version contains two refinements:

- The arbitrary traction model in user programmable subroutine, Adrx7, can now be used for roller/flange and all contacts, in addition to the main load bearing rolling element to race contact. This has resulted in some new options in the traction input data records.

- For user defined visco-elastic models the variation of shear modulus and critical shear stress as a function of pressure and temperature is now defined by a polynomial relation rather than an exponential relationship as used for viscosity.

Race flange contacts in roller bearings

The following minor enhancements to the roller/flange contacts apply to all roller bearings:

- Roller/flange output now contains radial position of contact point on the roller and both slip and entrainment velocity in the contact.

- The user defined load-deflection relation for flange contacts in user programmable subroutine, Adrx2, can now be used for roller/corner interaction in cylindrical roller bearings.

Arbitrary external loading in user programmable subroutine

The data interface to prescribe time-varying arbitrary external loads in user programmable subroutine Adrx1 can now include moments on the rolling elements races and cage.

Race geometrical imperfections

For roller bearings the input data records for race geometrical imperfections are expanded to include:

- Orientation of elliptical race profile relative to the race fixed coordinate frame.

- Race taper or coning angle for cylindrical roller bearings.

- More generalized expressions to permit variation of geometrical imperfections as a function of angular position on the race.

Miscellaneous enhancements

ADORE version 5.60 also includes the following minor enhancements:

- Introduction of a new character string variable, jVer, in the data module "Constants" to track user modifications and/or enhancement of the code. Whenever any user modifications are implemented either in the main code or in the optional subroutines, a user version identifier may be set in this variable. This identifier appends the main user version included in all output and ADORE data sets.

- Material property check when arbitrary material properties are set by the user. This confirms that all properties are set properly, failing which a diagnostics message is generated.

- A number of unused variables, which are tagged by some compilers have now been removed.

- Tab characters in some parts of the source code are now replaced by hard spaces to maintain code format requirements by certain compiler.

Code Corrections

The following errors in the code, corrections to which was provided via temporary fixes, have now been properly fixed and the related code modifications are now permanent:

- Error in race transformation matrix related to computation of roller/race slip at the outer race contact in tapered roller bearings. The error affects tapered roller bearings only.

- Placement of initialization calls to the user programmable subroutine Adrx6. Error affects optional data input when using the user programmable subroutine Adrx6.

- Data flag related to storing time-varying data in user programmable subroutine Adrx1. Error only affects storage of user data in subroutine Adrx1, when such data is interfaced with external codes for further analysis and/or graphic processing.

- Error in computation of roller/flange slip velocity. The error is only significant when roller/flange traction has a strong slip dependence.

ADORE User Manual

ADORE user manual has been appropriately modified to reflect the enhancements discussed above. The new version of the manual is included in the code distribution disk.

ADORE Input, Plot and Animation Facilities

As discussed above, some of the code enhancements have resulted in new input data. Thus the old input data sets will no longer be compatible with this new version. However, the old input data files may be opened with the new version of the input facility, AdrInput, distributed with ADORE 5.60, and appropriate modifications to the data can be easily made. The affected data records are 3.3, 5G.xx, and 10.0. When opening the old data files considerable care must be exercised in examining the data on these records.

Modifications to the Plot and Animation facilities were only required to incorporate the newly defined user version variable. Since this data is transmitted to these facilities via ADORE data sets, none of the newly generated data sets will work with old facilities. Also, any of the old data sets will not be compatible with the new facilities.

ADORE Print Output

Modifications to ADORE print output simply consists on the following:

- Inclusion of user version when set appropriately in the data module "Constants".

- New output variables in the roller/flange interaction output.

Test Cases

Starting with this version a tapered roller bearing example is also included in the program distribution disk. Thus for the test cases, there are now three subdirectories, Ball, Roller and TaperedRoller, containing test cases for ball, cylindrical and tapered roller bearings. As usual the input data, print output and all plot data sets are included in these 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.

While comparing the results with those produced by earlier versions some differences in the transient solutions and time step sizes may be observed. These difference are primarily due to code corrections and enhancements outlined above.

Program File Contents:

As usual 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:

Disk1

Update560.pdf:

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

adoreInput.txt:

A text file containing details of ADORE input data.

adoreManual.pdf:

ADORE user's manual containing detailed instructions for program installation and use.

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 program able examples via subroutine ADRX1.

Disk2

*.f files:

ADORE FORTRAN-90/95 source files

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.

Program Installation

On the Windows system, if the Microsoft Developer Studio is used to create the executable, the following suggested procedure may be helpful.

1. Start Microsoft Developer Studio and select the File option to create a new project.

2. For type of application, select "Console Application" and name the application as adore560 or other desired name.

3. Once the project space is created, use the inert option to add source files. After navigating to the appropriate source directory, first add the file m_parameters.f only. In the second step add all the m_*.f module files. In the final step all the other source file. The file to be added is simply selected by a mouse click on the file in the selection widow.

4. Now use the Build option to create the executable.

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 install these facilities.

The setup files for the three applications may then be edited to update the paths and installed in appropriate directory compatible with the environmental variables which provide access to all executables.

Contact Information

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