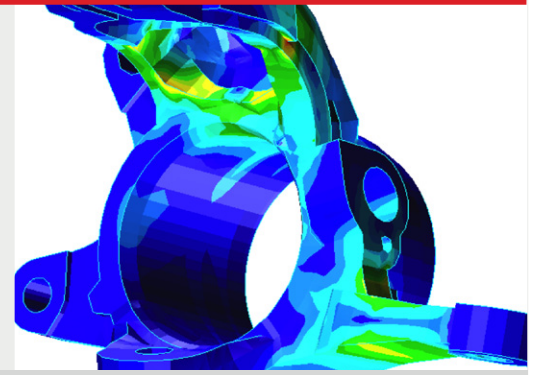


MSC Nastran™ Embedded Fatigue

Faster Time To Market

Light Weighting/Component Optimization

Converge Fatigue & Stress Functions



- **FASTER** - Drastically reduce the time to complete large fatigue and durability simulations
- **SMALLER** (file sizes) - Thereby increase fatigue analysis model sizes: There is no theoretical limit to the size of model that can be handled
- **SIMPLER** - Remove the need for intermediate data by combining the traditional 2 separate processes of stress and fatigue analysis
- **PORTABLE** - Easier model portability by embedding the process within the MSC Nastran input file
- **TRANSPARENT** - The fatigue process is far more transparent thereby allowing a stress analyst to include a fatigue calculation with every stress run
- **BETTER DESIGNS** - Optimize fatigue calculations by coupling fatigue analysis and an optimization solution

What is MSC Nastran Embedded Fatigue (NEF)?

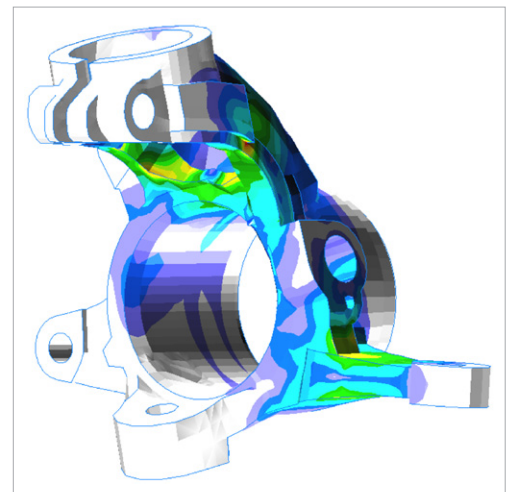
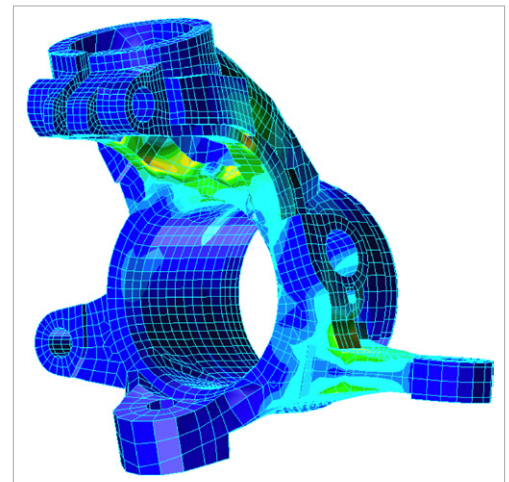
Fatigue failures are often identified through testing. However, since the advent of FE based stress solvers, starting with Nastran in the 1960's, attention has focused on the concept of FE based fatigue calculation procedures. MSC Fatigue (1990) was the first such commercial package and spawned a proliferation of similar commercial FE based tools. These methods, both test and FE based, treat the fatigue calculation process as a post processing task and this has been an accepted convention throughout.

MSC Nastran Embedded Fatigue (NEF) breaks this convention by coupling the stress and fatigue calculation process into one simultaneous operation. This new immersed capability has wide ranging implications in relation to the way fatigue and reliability is handled within large mechanical engineering organizations. By combining the 2 separate processes into one simultaneous process the need for any kind of intermediate data is removed. Such intermediate files can sometimes be a limiting factor in the size of model that can be handled. With NEF there is no limit, theoretically, to the size of model that can be handled (practically this will be governed by normal Nastran model size limitations).

Also, by embedding the process with MSC Nastran, the analyst can include the materials and loading information with the model data in the Nastran input file. This means that model portability becomes much easier. Another significant new capability will be created by enabling optimization procedures to be coupled with fatigue as the constraint, via a SOL200 type analysis. And finally, because the fatigue process is far more transparent (within this solver embedded process) it will open up the opportunity for an analyst to request fatigue results output with every stress run.

About MSC Software's Fatigue & Durability Products

MSC Software has been at the forefront of FE based fatigue and durability products for over 25 years. **MSC Fatigue** (coupled with Patran) was created in 1990 as a tool for calculating both fatigue damage and crack growth rates from FE models. **Adams** is a vital tool for modeling the loads that are an essential input to the fatigue calculation process. **Marc** can be used to calculate arbitrary crack directions and rates in non uniform geometries and can also be used to generate the Compliance Functions needed for the crack growth module of MSC Fatigue. Marc can also be used to generate nonlinear stress-strain data for use in a subsequent Low Cycle Fatigue calculation. **Digmat** is a powerful tool for handling, converting and processing the materials data needed for a subsequent fatigue calculation. **Actran** can be used to process acoustic response data for inputting to MSC Fatigue. **MSC Nastran** acts as the stress tool of choice in most large mechanical engineering companies and now **MSC Nastran Embedded Fatigue** combines these stresses with the often-required fatigue calculation.



New Nastran Case Control Command

FATIGUE Case control entry to specify that fatigue output is required

New Nastran Bulk Data Entries

FTGPARAM Defines various fatigue parameters such as the type of fatigue analysis

FTGDEF Defines areas (elements) of the model on which to perform fatigue analysis

SET4 A new SET for grouping by properties

FTGSEQ Defines a sequence of load events, sometimes referred to as a duty cycle

FTGEVNT Defines loading events consisting of one or more simultaneously occurring cyclic loading definitions

FTGLOAD Associates loading from a particular subcase or mode to its time variation

TABLFTG Defines the cyclic variation of a particular load

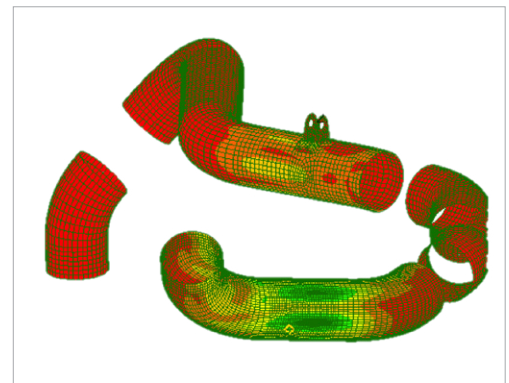
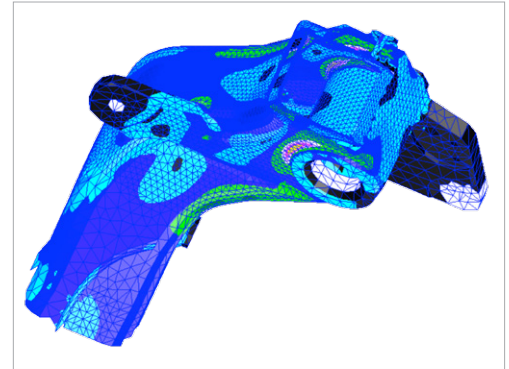
UDNAME Alternate method to associate the cyclic variation of a particular load to an external file

MATFTG Defines cyclic material properties in the form of S-N or ϵ -N data

PFTG Defines various physical fatigue properties to the elements of interest

DRESP1 Defines fatigue responses in optimization (SOL200) runs

DTI, UNITS Specifies the model analysis stress units



Fatigue Capabilities in MSC Nastran 2013 Release

- Stress-Life solver (full capabilities similar to MSC Fatigue)
- Strain-Life solver (full capabilities similar to MSC Fatigue)
- Factor of Safety (FOS) analysis (both S-N & E-N)
- multi axial responses processed using Critical Plane method
- Parallel Processing (up to 100 threads)
- Utilities Tools
- Multiple Fatigue Analysis can be performed in a single job submittal

Supported Nastran Solution Routines (in 2013)

- SOL 101 – statics
- SOL 103 – normal modes
- SOL 112 – modal transient
- SOL 200 – optimization (ANALYSIS=STATICS only)

Results Formats

- MASTER/DBALL file
- Output2 (OP2) file
- F06 (ASCII output) file
- Comma Delimited CSV (Excel) file
- FEF (Patran results) file
- FER (Design Life) file
- Universal (UNV) file

Pre & Post Support

Patran 2013 and beyond supports pre and postprocessing using either the MASTER/DBALL or OP2 file attachment capability, or import of FEF or FER files. For alternative Pre & Post tools, one of the alternative output formats specified above may be used (MSC is not responsible for these alternative output formats but provides them as a convenience to the user).

Available Documentation

- MSC Nastran Quick Reference Guide (QRG) with NEF entries
- MSC Nastran Embedded Fatigue User's Guide with worked examples
- MSC Nastran Release Guide