Utilizing Multiple Processors in Parallel to Reduce Analysis Time

OVERVIEW
SimOffice™ is a stand-alone environment in which engineers can build, test, review, and improve their designs. SimOffice gives product development engineers the shared technologies they need to assess product performance and accelerate innovation.

The MSC.Nastran™ product family is modular, enabling you to analyze products ranging from simple components to complex structures and systems. This also enables you to start simply and to grow your analysis capabilities as your Virtual Product Development (VPD) needs expand. As part of your VPD process, you can use MSC.Nastran to assess many functional aspects of your products, such as the structural response (displacement, strain, stress, vibration, and temperature) due to its material properties and the loads and boundary conditions that are applied to it during operation.

MSC.Nastran™ DMP
The MSC.Nastran™ DMP module provides the capability to take advantage of computer hardware containing multiple processors or a set of networked computers with single or multiple processors to solve complex analysis problems faster. Three methods of parallel domain decomposition are available in which to divide and perform an analysis: the Geometric Domain (GD), the Frequency Domain, and the Degree of Freedom (DOF) or Matrix Domain (MD). The ability to analyze problems across multiple domains in parallel ensures that more problems can be solved in less time allowing for more design iterations and improved efficiency. With MSC.Nastran DMP, a dramatic reduction in analysis time can be seen for static, dynamic frequency response, normal modes, or design optimization problems. MSC.Nastran DMP provides scalability with best results utilizing 2 to 64 processors, but performance results can vary depending on the type of problem.

MSC.Nastran DMP allows you to maximize the utilization of today’s high-performance, lower-cost computing hardware to reduce time, increase efficiency, improve designs with more iterations, and reduce costs with the same accuracy and robustness as MSC.Nastran without DMP. DMP also provides three methods to solve problems that could not be solved otherwise or to cross check results.

In one automotive example using MSC.Nastran DMP with Normal Modes analysis up to 400 Hz., for a model with over 1.4 million degrees of freedom, solution time was reduced from 3 hours 15 minutes to 35 minutes using 24 processors while obtaining the same results.

DMP is ideally suited for clusters of cost-effective workstations, allowing for flexibility in machine configuration and additional cost savings.

PRODUCT LINE
SimOffice™
Product Family
MSC.Nastran™

CAPABILITIES
• Utilize Current Computer Multiprocessor Technologies in Parallel to Reduce Solution Times.
• Distribute Problem Solutions to Multiple Computers in Parallel to Reduce Solution Times.
• Make Use of Alternate Parallel Decomposition Methods for a Quick and Robust Solution.
• Take Advantage of Alternate Parallel Decomposition Methods to Double-Check Results.
• Accessible from a Variety of Analysis Types Including:
  – Statics.
  – Dynamics.
  – Normal Modes.
  – Design Optimization.
  – Custom Solutions via DMAP.
• Available in Combination with the MSC.Nastran ACMS Module.
• Performs in Both Networked Cluster and SMP Environments.
• New Additional Multi-Level DMP Capability Providing Hierarchic-Parallel Processing to Extend and Scale Problem Solutions to 64 Processors.

BENEFITS
• Utilize Current Hardware Technologies such as Multi-processor and Cluster Configurations to Maximize Your Return on Hardware and Software Investments.
• Reduce Solution Time for All of Your Basic Engineering Analysis Types.
• Reduce Costs Associated with Large Models and Long Analysis Times.
• Increase Productivity by Solving Larger, More Complicated Models in Less Time.
• Enhance Your Ability to Collaborate and Analyze More Design Iterations.
Geometry Domain Parallel Method
The Geometry Domain parallel method is effective for large solid models with high-stiffness and low modal density and where dividing the problem into smaller pieces based on the model geometry is suitable. In MSC Nastran DMP, a domain decomposition in the Geometry Domain results in independent substructures and a common boundary. The substructures are solved simultaneously in parallel and inter-process communication is used to derive a solution at the boundary. The Geometry Domain parallel method is available in combination with the following MSC Nastran product modules: Statics, Normal Modes, and Automated Component Modal Synthesis (ACMS).

Matrix (DOF) Domain Parallel Method
The Matrix Domain parallel method is very effective for problems that involve a very complex geometry, a large number of rigid elements, and a large number of degrees of freedom. Whereas Geometric Domains, comprised of grid points and elements, are determined before constraint elimination, Matrix Domains are DOF sets, which are defined after the elimination of all constraints. Domain decomposition is then performed on the global analysis matrix connectivity. By postponing the domain decomposition until after constraint elimination has taken place, advantages of speed and robustness are available compared to the Geometric Domain method. The DOF Domain parallel solution method is available for the following MSC Nastran solution sequences: statics, normal modes, modal dynamics, and design optimization (SOLs 101, 103, 111, 112, and 200 respectively).

Frequency Domain Parallel Method
The Frequency Domain parallel method is best suited for large analysis problems that require a large number of frequency calculations or response frequencies. MSC Nastran dynamic modal solutions (SOLs 103, 111, 112) and the MSC Nastran ACMS module all benefit from this technology. For a normal modes analysis, it is possible to distribute the desired frequency range across available processors, thereby solving small sub-ranges of the problem in parallel. It is also possible to combine this solution with other parallel methods, where each sub-range is solved with multiple processors using either the Matrix Domain or the Geometry Domain parallel method. For frequency response computations, the solutions calculated at each frequency are independent from each other, such that a parallel solution is trivial to obtain. For direct frequency response analysis (SOL 108), the parallel method provides nearly linear speedup in solution times, achieving maximum scalability.

EXTEND YOUR INVESTMENT
MSC.Software recommends MSC.Patran” or MSC.SOFY™ for an integrated modeling and analysis environment.

MSC.MasterKey™ delivers a flexible, token-based licensing system that provides access to the breadth and depth of MSC.Software’s world-class Virtual Product Development software portfolio, allowing you to use whatever simulation tools you want, whenever you need them – maximizing your productivity and reducing cost.

MAXIMIZE YOUR RETURN ON INVESTMENT
MSC.Software provides the most comprehensive training, support, and professional services with offices worldwide to provide local and centralized support. Investing in MSC.Software gives you access to extensive client support through comprehensive documentation, direct technical expertise, and customized onsite and offsite training classes taught by experienced engineers.

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