

GiD 2010
**5th Conference on Advances
and Applications of GiD**

1st Kratos Workshop

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PREFACE

The extended use of simulation programs has leaned on the advances in user-friendly interfaces and in the capability to generate meshes for any generic complex geometry. More than ten years of development have made GiD grow to become one of the more popular pre and post processing systems at international level. The constant dialogue between the GiD development team and the users has guided the development of GiD to cover the pre-post needs of many disciplines in science and engineering. Following this philosophy, the biannual GiD Conference has become an important forum for discussion and interchange of experiences among the GiD community.

This year the 1st Kratos Workshop has joined the GiD Conference. Kratos is an open source multi-physics FEM platform developed in CIMNE, which community (users and developers) begins to grow all over the world, and which have been always very close to GiD philosophy. The workshop aims to provide a meeting point for developers and users to facilitate the interchange of experiences and of new ideas.

This book includes the contributions of the participants to the fifth edition of the GiD Conference and 1st Kratos workshop, held in Barcelona from 26 and 27 of May 2010. Sessions related to specific areas were complemented by Keynote lectures on targeted research topics in the field of pre and postprocessing given by reputed international experts. Unfortunately, these Keynote lectures could not be included in this book.

The following list gives an indication of the topics addressed in the conference:

GiD Conference:

- Interface with CAD data (IGES, VDA, DXF, etc.)
- CAD data repair
- Mesh generation
- Medical images treatment
- Remote computing
- Interface between GiD and commercial codes
- Visualization and animation of numerical results
- Advanced visualization modes such as stereoscopic 3D view

- Examples of application of GiD in science and engineering
 - › GIS
 - › Geotechnics
 - › Multi-physics
 - › CFD
 - › Structural analysis
 - › Electromagnetics
 - › Physics
 - › Chemistry
 - › Bio-Engineering
 - › Industrial processes
 - › Others

Kratos workshop

- Kratos applications in different science and engineering fields
- New developments in Kratos
- Practical solutions of Multi-physics problems
- Parallel Kratos: Distributed, Multi-threaded and GPGPU
- New interface between Kratos and GiD

On behalf of all who have been involved in the organization of the GiD Conference & Kratos workshop and in the edition of this book, we would like to thank all authors contributing to this publication. We also hope that the different practical cases selected in this book will help towards new developments and advances in the pre and post-processing field and in future versions of GiD, as well as towards new developments in Kratos environment.

Abel Coll
Pooyan Dadvand
CIMNE Co-Chairmen of GiD Conference 2010
and Kratos workshop

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NEUTRAL FILE GENERATION FOR GiD POST-PROCESSING USING PAK SUBROUTINES IMPLEMENTED IN FEAP

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Key words: GiD, FEAP, PAK, program interface, neutral file

Abstract: *GiD - FEAP interface is a user interface between program for pre- and post-processing – GiD and Finite Element Analysis Program - FEAP. Basic instructions for interface implementation are given in this paper. Original subroutines from PAK-S program module implemented with necessary corrections in FEAP program module provide neutral file essential for GiD post-processing. Several finite element types are implemented in this program interface as well as several material models. Also, a few benchmark examples used in FEAP and PAK-S program manual are prepared and tested in order to validate interface functionality. Developing GiD – FEAP interface we have improved GiD compatibility with powerful software for complex structural analysis FEAP and also we have made interesting triangle with our subroutines from PAK software.*

1 INTRODUCTION

FEAP¹ is shortcoming from Finite Element Analysis Program developed by R.L.Taylor at the University of California, Berkeley and it is widely used as academic software at many institutes and universities. Also, software package PAK, developed at Faculty of Mechanical Engineering in Kragujevac, is very useful tool for solving structural analysis problems. It has many built-in finite elements and material models and also includes modulus for static and dynamic analysis, geometrically and materially nonlinear problems, fracture mechanics, etc. PAK-S² has already had subroutines for printing results in neutral files in proper format and they are used with necessary modifications in FEAP code to prepare neutral format file for GiD³ post-processing. Already existed subroutines are connected to FEAP with minimal changes to print values in NEU file which can be imported in GiD and many other post-processing softwares (FEMAP, etc.)

2 IMPLEMENTATION OF PAK-S SUBROUTINES IN FEAP

In Laboratory for Engineering Software at the Faculty of Mechanical Engineering

(University of Kragujevac), PAK-S has been developed and used as platform for finite element methods analysis and research. As post processors are often used FEMAP and GiD, because both can import neutral file format and PAK-S produces such file during the analysis process. Also, FEAP is used as control software for results comparison and as learning tool in education on this faculty. The version 8.2 of FEAP has many new capabilities but still doesn't have solution for post-processing with some external softwares. To enhance this capability, it was decided to develop interfaces between FEAP and GiD because of its simplicity and powerful capabilities.

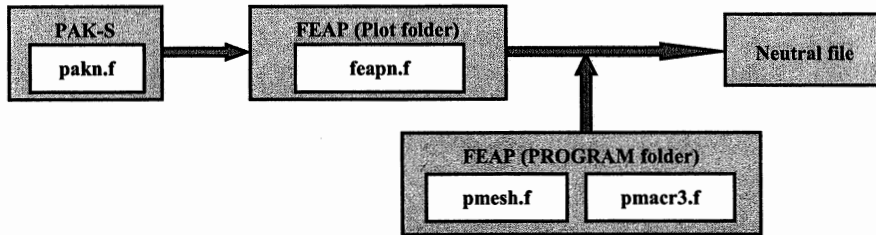


Figure 1: Scheme of implementation PAK-S subroutines into FEAP for plotting mesh and results of deformation

In the *pkn.f* file, there are subroutines necessary for printing values from PAK-S memory in the neutral file (Figure 1). Those subroutines are called at the proper places in PAK code in order to organize data in proper way. As that subroutines are also written in FORTRAN and known variables are necessary for their functionality, implementation in FEAP code was just routine job. FEAP code is organized in many folders but the main subroutines are in PROGRAM directory. Modified subroutines in *pkn.f* file are moved to new file called *feapn.f* and stored in the PLOT folder because subroutines are used for plotting in NEU file. The *pmesh.f* file in PROGRAM folder was changed with lines which call subroutines necessary for mesh preparation and displaying. After the problem is solved results are stored in "hr" array at the defined location. With such information we can call subroutine which will print results in desired format.

3 DESCRIPTION OF FEAP INTERFACE IN SOFTWARE GiD

Scheme of solving problem applying software GiD and FEAP, using developed interface described in this paper, is given on the Figure 2.

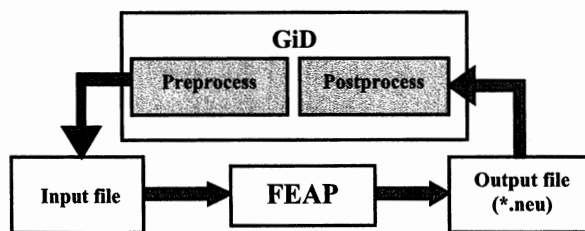


Figure 2: The communication between GiD and FEAP

After defining of a model in the mode for pre-processing of program GiD, we get an ASCII file without extension on the output. This file is sent to solver FEAP and on its output we get a *.neu* extension file that contains the results of the previously done analysis. Obtained result can be post-processed now in the mode for post-processing of GiD program.

A new folder with the solver name (FEAP in this case) within the existing *Problem types* folder is created. This way FEAP submenu will appear in GiD *Problem type* submenu. Then we created *GiD-FEAP.gid* folder within FEAP folder. The entire interface that contains the following files will be placed in *GiD-FEAP.gid* folder:

Configuration files

- GiD_FEAP.cnd
- GiD_FEAP.mat
- GiD_FEAP.prb

TCL extension files

- GiD_FEAP.tcl

Template files

- GiD_FEAP.bas

4 ANALYSIS OF GiD-FEAP INTERFACE FILES

File *GiD_FEAP.cnd* has the information about problem boundary conditions (constraints and forces). The structure of *GiD_FEAP.cnd* file is organized in one *BOOK* containing data about *Point Constraint*, *Nodal Forces*, *Nodal Displacement*, etc. Dialog window with some features of this file is presented on the Figure 3 below.

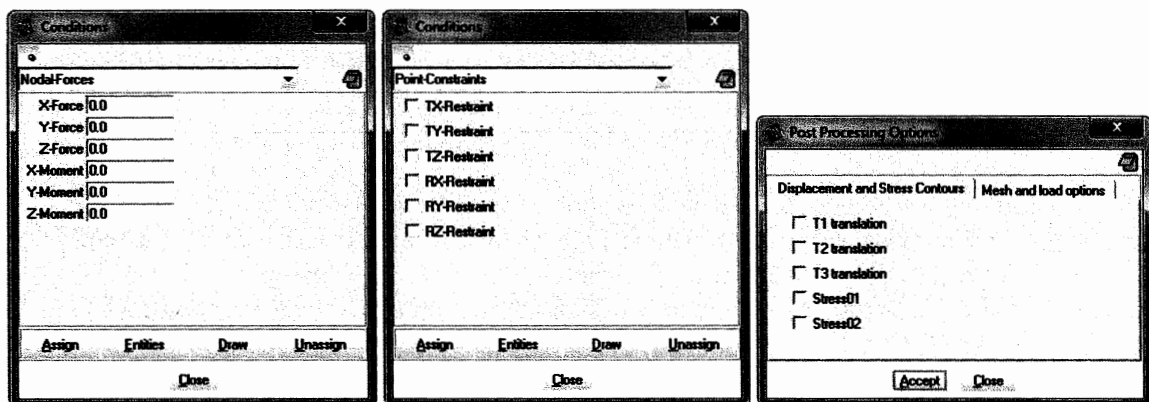


Figure 3: Dialog windows from *GiD_FEAP.cnd* and *GiD_FEAP.prb* file

File *GiD_FEAP.mat* has the information about material models (*Material*). This file is starting with *BOOK Material* and material models are dependent from the finite element types and their characteristics. Several different material models are implemented in this interface from which we can extract: *Solid Elastic*, *Solid Plastic*, *Plate Elastic*, *Truss Elastic*.

GiD_FEAP.prb file has the information about the analysis type, post processing options, equilibrium iterations, permanent constraints, problem type, deformation type, etc. The information being input here is used to set the solver parameters. Dialog window for defining *Post Processing Options* in the GiD graphical interface is presented on the Figure 3 above.

File with the **.tcl* extension automatizes any of the processes in GiD and new options can be assigned with it. The appearance of the entire FEAP interface is defined within it, including the appearance of the created menu and submenu. *GiD_FEAP.tcl* consists of numerous procedures that correspond to *TCL* language.

Within interface folder we create *GiD_FEAP.bas* file that represents the main part of the

interface between these two programs. After defining of a model it is necessary to write all the information in the input file that will be processed by FEAP solver.

5 ANALYSIS OF RESULTS

In this paper, we introduce results for example from FEAP Example manual. The problem that is considered is a circular disk loaded by two concentrated forces of 10 units each directed along a diagonal. As we can see, FEAP and PAK-S give similar results for all nodes and GiD is common post-processor for both softwares.

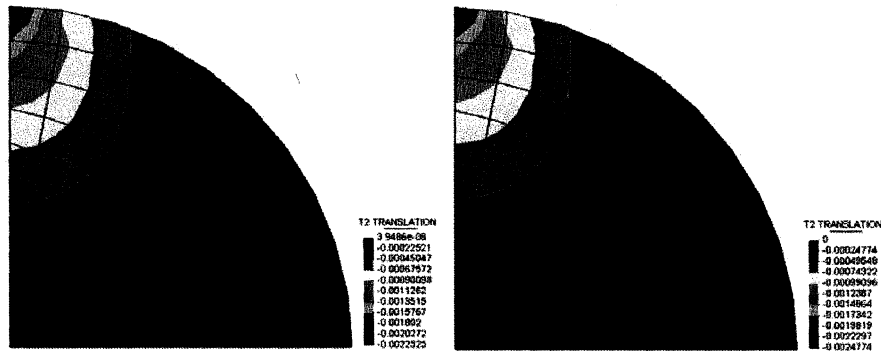


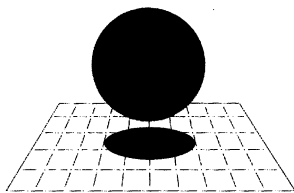
Figure 4: Contours of vertical displacement for circular disk calculated using FEAP and PAK-S

6 FUTURE DEVELOPMENT

The developed enhancements represent a common possibility for many post-processors to be connected with FEAP. The availability of the FEAP source code at Faculty of Mechanical Engineering in Kragujevac and development of domestic software PAK have produced easy implementation of existing subroutines which give powerful neutral file format. Currently, displaying of mesh data for 1D, 2D and 3D solid elements are implemented and also some output results can be post-processed. Future work should be directed to implementation of all necessary subroutines and full synchronization PAK-S with FEAP.

REFERENCES

- [1] R.L. Taylor, *FEAP - A Finite Element Analysis Program, Version 8.2 Example Manual*, Department of Civil and Environmental Engineering, University of California at Berkeley, USA, 2008
- [2] M. Kojić, R. Slavković, M. Živković, N. Grujović, *PAK-S, PROGRAM FOR FE STRUCTURAL ANALYSIS, USERS MANUAL*, Faculty of Mechanical Engineering of Kragujevac - Laboratory for Engineering Software, Kragujevac, Serbia, 2003
- [3] R. Ribó, M. Pasenau, E.T. Escolano, J.S.P. Ronda, A.C. Sans, A.M. Ribera, S.G. Horcas, *GiD - Reference Manual, Version 9*, CIMNE, Barcelona, Spain, 2008
- [4] R. Ribó, M. Pasenau, E.T. Escolano, J.S.P. Ronda, A.C. Sans, A.M. Ribera, S.G. Horcas, *GiD - User Manual, Version 9*, CIMNE, Barcelona, Spain, 2008
- [5] D. Rakić, A. Nikolić, M. Živković, R. Slavković, *GID-PAK INTERFACE*, 4th Conference on Advances and Applications of GiD, Ibiza, Spain, 2008



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