Software and Computer-based Instructional Materials
VisualFEA by Jae Young Lee

VisualFEA (Finite Element Analysis) Collection	https://ecommons.cornell.edu/handle/1813/43749
Computer Program: **VisualFEA** (Windows and Macintosh versions)	http://hdl.handle.net/1813/43778

AUTHOR: Lee, Jae Young

ABSTRACT: VisualFEA is an easy-to-use but powerful finite element analysis program, full-fledged with pre- and post-processing capabilities. The program has a unique feature for computer-aided education of structural mechanics and finite element method. The educational functions cover a number of topics in the subjects. They are devised to enhance understanding of complex concepts and procedures through graphical simulation and visualization. The program is provided here as a teaching aid for instructors and as a practicing tool for students.

DESCRIPTION: Hardware requirement for Computer Program(Windows) is Windows PC with Windows XP, 7, 8, 10... Processing Size limit: 1,000 nodes...Time limit: none.

Hardware requirement for Computer Program(MacOSX) is Macintosh (Intel) with OSX...Processing Size limit: 1,000 nodes...Time limit: none.

Contact jylee@jbnu.ac.kr to obtain a free extended version for use in lecture courses

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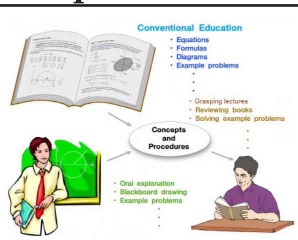
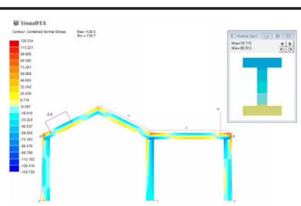
	11 - Computer-aided Education of Structural Mechanics and Finite Element Method Using VisualFEA ***Companion Document:*** Finite element implementation for computer-aided instruction [PDF] (528.4Kb) http://hdl.handle.net/1813/43750	The presentation in this video explains the meaning and effectiveness of computer-aided education in structural mechanics and finite element method. The educational functions are introduced as a unique and special feature of VisualFEA. The introduction includes a brief overview on the topics of the subjects covered by the program. The procedure of computer-aided education is demonstrated with two examples, one for structural mechanics and the other for finite element method.	21
	21 - An example of 2D frame http://hdl.handle.net/1813/43753	This screen demo exemplifies structural modeling of a simple 2 dimensional frame, using VisualFEA. The program is featured by interactive modeling and visualization through real-time analysis. This show how to create a frame model and examine the structural behavior in reponse to the variation of external forces, boundary constraints, and member properties. Interactive representation of internal forces is a unique educational feature of VisualFEA.	15

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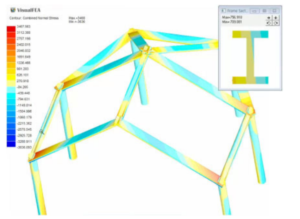
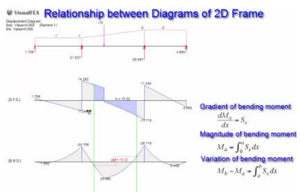
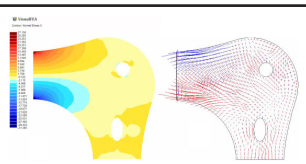
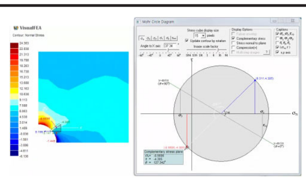
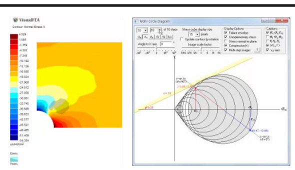
	22 - Modeling of 3D Frame http://hdl.handle.net/1813/43754	This screen demo introduces important features of 3 dimensional frame modeling by Visual FEA. Namely, procedures of constructing a 3 dimentional frame, user interface for handling 3 dimensional coordinates, representation of 3 dimensional analysis data, and so on. The demo shows 3 dimensional rendering of stress contour image and recovering the detailed analysis results.	23
	23 - Relationship between Diagrams of 2D Frame http://hdl.handle.net/1813/43755	The interactive operation with frame diagrams is introduced as a method of examining the mathematical relationships between shear, bending moment and deflection diagrams of a structural members. The differentiation and integration of internal forces are illustrated graphically using the slope and area of the diagrams. The response to variation of input conditions is dynamically represented by instant update of the diagram.	14
	31 - An example of plane strain case http://hdl.handle.net/1813/43762	This screen demo shows the basic procedure of finite element analysis by VisualFEA, using a simple example of plane strain case. The preprocessing, solving and postprocessing stages are explained through the step-by-step progress of defining outlines, generating meshes, assigning attributes, solving and visualizing analysis results. The look and feel of the program as well as its usage can be grasped from this demo.	22
	32 - Mohr's Circle - Linear http://hdl.handle.net/1813/43758	This video shows an educational function for teaching and learning the concept and usage of Mohr's circle in solid mechanics. A Mohr's circle is drawn using the stresses at a point of a plane or a three dimensional solid model. Various graphic visualization and tooltip information illustrate the representation of stress state by the Mohr's circle. The coordinate transformation of stresses is also demonstrated.	19
	33 - Representation of Elasto-plastic Behavior Using Mohrs Circle http://hdl.handle.net/1813/43759	This screen demo shows how Mohr's circles can be used in representing the elasto-plastic behavior in finite element analysis. The transition of stress state from elastic to plastic is illustrated by the image of incremental Mohr's circles and envelope curve. The characteristics of plastic yield criteria and their significance can also be observed by comparing the Mohr's circles for the stresses under different criteria.	10

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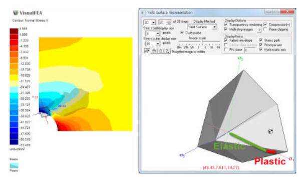
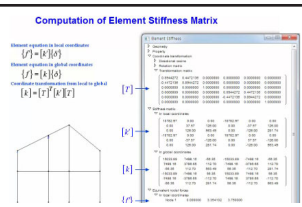
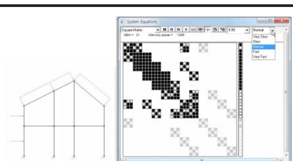
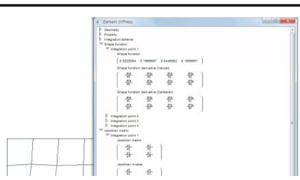
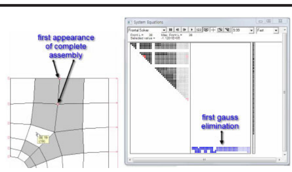
	34 - Representation of Elasto-plastic Behavior Using Yield Surface http://hdl.handle.net/1813/43764	This screen demo will show how the elasto-plastic behavior can be represented by the yield surface under a given plastic yield criterion. In this demo, a quarter section of a plate with a hole was modeled as a plane strain case with elasto-plastic material behavior. The concepts of yield surface and stress path can be understood through interactive manipulation of graphic images representing the state of stresses.	13
	41 - Computation of Element Stiffness Matrix http://hdl.handle.net/1813/43756	A simple example of a frame model is presented to show how to examine the computational details of the element stiffness matrix, using the educational function. The items of computation include the element stiffness matrix and force vector, respectively in local and global coordinates, and transformation matrix for coordinate transformation. The demo shows the alternative methods of representing the information either by the numerical values or symbolic expression.	11
	42 - Processing of Finite Element Stiffness Equation http://hdl.handle.net/1813/43757	The video demonstrates interactive simulation of assembling stiffness matrices and force vectors into the system equations, comparison of different assembly methods, and node and element numbering for the computational efficiency. This demo is a continuation of the demo about element stiffness matrix of 2-D frame model in the file named, FrameElem.mp4.	16
	43 - Computation of Element Stiffness Matrix: Plane strain case http://hdl.handle.net/1813/43760	This screen demo introduces an educational function of VisualFEA for teaching and learning the procedure of computing element stiffness matrices in finite element method. The step by step process of numerical integration is displayed using graphical images and numerical expressions. The purpose of the function is to study the computational details through inspecting the numerical data produced in the integration process.	11
	44 - Processing of Finite Element Stiffness Equation: Plane strain case http://hdl.handle.net/1813/43761	The function covers interactive simulation of assembling stiffness matrices and force vectors into the system equations, comparison of different assembly methods, and node and element numbering for the computational efficiency. Drag-and-drop assembly of element stiffness matrix is graphically simulated for intuitive understanding of the process. This demo is a continuation of the demo about element stiffness matrix of plane strain model in the file named PlaneElem.mp4.	18

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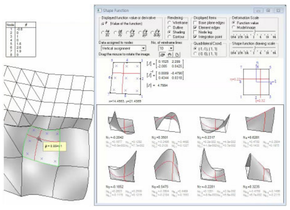
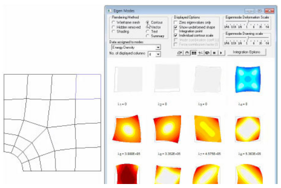
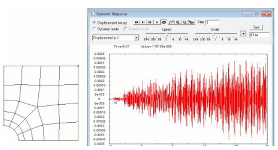
	45 - Interpolation and Shape Function http://hdl.handle.net/1813/43763	This screen demo introduces an educational function of VisualFEA, related to intra-element interpolation of nodal values using shape functions. This feature of the program is intended to help understand the nature of the shape functions and computational aspects of interpolation. The characteristics of element modeling can be examined through the graphical representation. They include the inter - element continuity related to compatibility of the shape functions between adjacent elements.	20
	46 - Eigen mode simulation http://hdl.handle.net/1813/43752	This screen demo introduces an educational function of VisualFEA, related to eigen mode simulation. The function is useful in teaching and learning the concept of eigenmodes and their implication in finite element behavior. This demo suggests how to use the eigenvalues and eigenvectors of the stiffness matrix for examining the characteristics of finite elements.	17
	47 - Eigen modes in Dynamic Analysis http://hdl.handle.net/1813/43751	This screen demo introduces an educational function of VisualFEA, related to usage of eigenmode, in dynamic analysis. A generalized eigenproblem is established from the dynamic equilibrium equation. The vibration modes are obtained from this eigenproblem, and the dynamic behavior can be represented as a time dependent combination of vibration modes. This video shows demonstration of the educational function to study the concepts and procedures of dynamic analysis based on mode superposition.	15

Some Applications of VisualFEA

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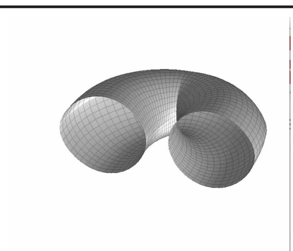
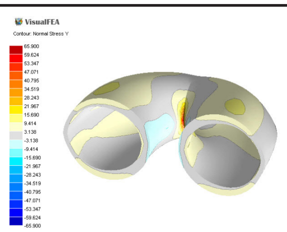
1. Stomatal Guard Cells

	Stoma Shell http://hdl.handle.net/1813/43793	A thin shell model of linear elastic deformation of half a kidney-shaped guard cell pair. See the background for this analyses in the paper: *"Shell analysis of elliptical guard cells in higher plants: a review"* at this URL.	1
	Stoma Solid http://hdl.handle.net/1813/43794	A solid model of linear elastic deformation of half a kidney-shaped guard cell pair	1

Some Applications of VisualFEA (continued)

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2. Palm leaf petiole-sheath juncture

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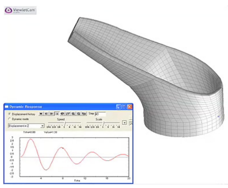
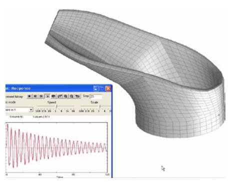
	Petiole–fundamental mode https://ecommons.cornell.edu/handle/1813/43791	See the background for this analyses in the paper “Finite element analyses of palm leaf petiole-sheath junctions” at this URL.	1
	Petiole–twisting mode http://hdl.handle.net/1813/43792	See the background for this analyses in the paper "Finite element analyses of palm leaf petiole-sheath junctions" at this URL.	1