CMS, University of Pune Lecture

Use of Modeling In Automobile & Aerospace Industry

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- Why use it?
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What it is & What it does

- Software products for design --
- Software for production --
- Software as an integrated part --

  -- of automobile/aircraft

What it is & What it does

Software in production:

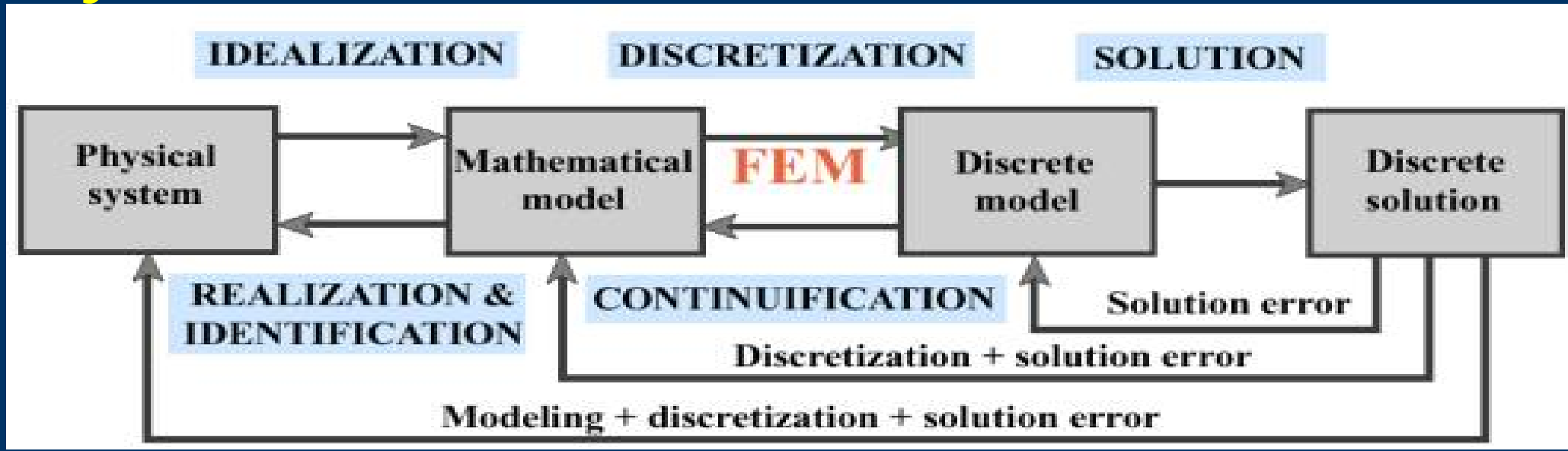
-- Mainly for managing product life cycle processes

-- Involves controlled manufacturing, controlled assembly lines and controlled instruments

What it is & What it does

Software products for design of vehicles:

-- simulation of a physical system (geometry and environment) by a mathematical approximation of real system



Why use it?

- Demanding requirements on environmental cleanliness, fuel efficiency, enhanced safety and comfort
- Software offers higher level of innovation
- Software allows exploration & experimentation without involved “real” material – through simulations
- Quality insured before manufacturing
- Cost effective solution

Trends – Analysis Facts

- Mechanics is a physical science, since it deals with the study of physical phenomena.
- The purpose of mechanics is to explain and predict physical phenomena and thus to lay the foundations for engineering applications.

Trends – Analysis methods

- Motion of solid bodies, pressure on solid bodies, or contact of solid bodies : **Structural**
- Applied heat, high temperature, or changes in temperature : **Thermal**
- Permanent magnets or magnetic fields : **Magnetic**
- Electric currents (AC or DC) : **Electric**
- Gases/fluids : **Fluid**
- Combinations of any of the above : **Coupled-field**

Trends – Underlying Principles

- Mechanics as the science which models and predicts the conditions of **rest or motion** of bodies under the action of forces
- Very important in automobiles/aircrafts for reducing air resistance, studying deformations, cracks, vibrations, buckling under action of various forces
- Material durability study – plasticity, elasticity, viscoelasticity (glass) etc.
- Contact and other changing status nonlinearities

Trends – Discretization Methods

- Using simple, interrelated building blocks (called “elements”) a real system with infinite unknowns is approximated with a finite number of unknowns.
- Finite Element Analysis is one such method - was first developed in 1943 by R. Courant
- Used numerical analysis and minimization of variational calculus to obtain approximate solutions to vibrational systems.

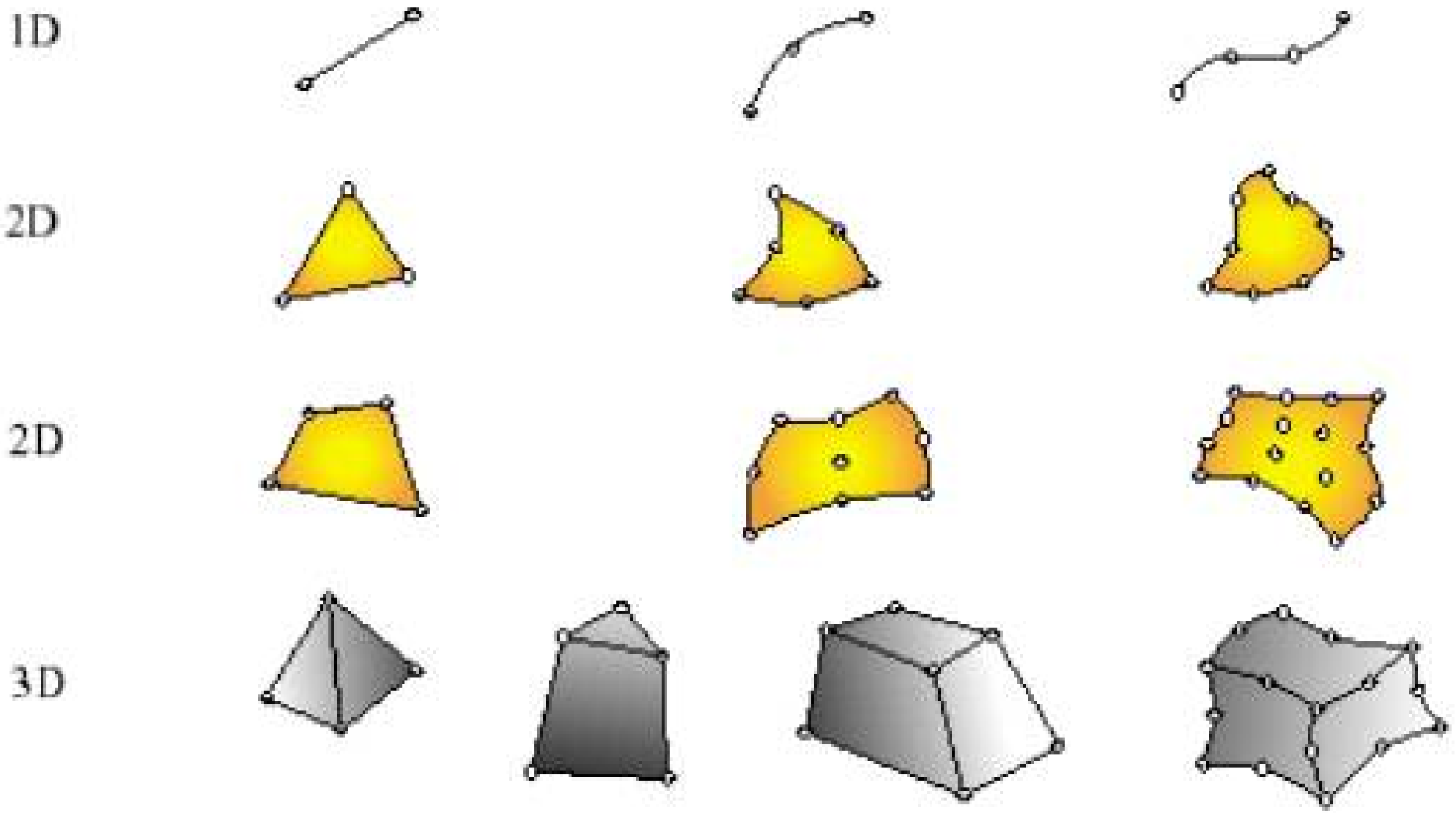
Trends – Discretization Methods

- Subsequenly, as computer hardware improved the better and faster methods were developed with broader application areas
- Superior CAE concepts have also emerged; it is not unusual to have a single CAD model for producing engineering drawings, carrying out kinematics & assembly analysis, as well as being used for finite element modeling.

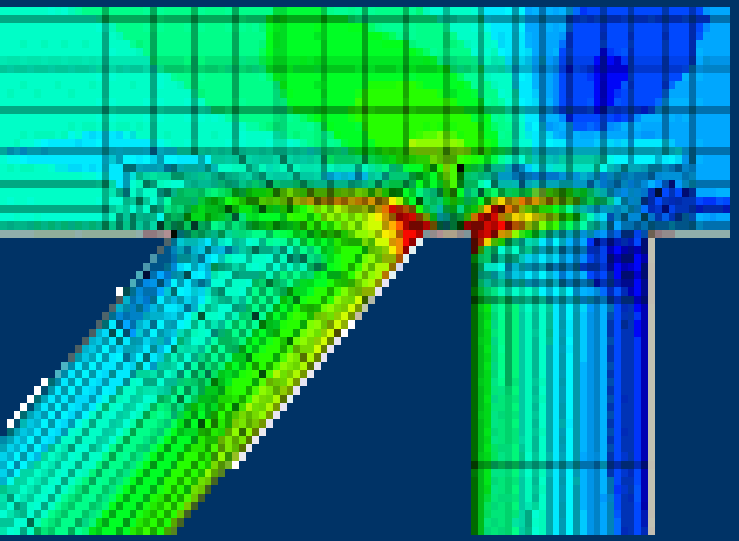
Trends – Simulation Process

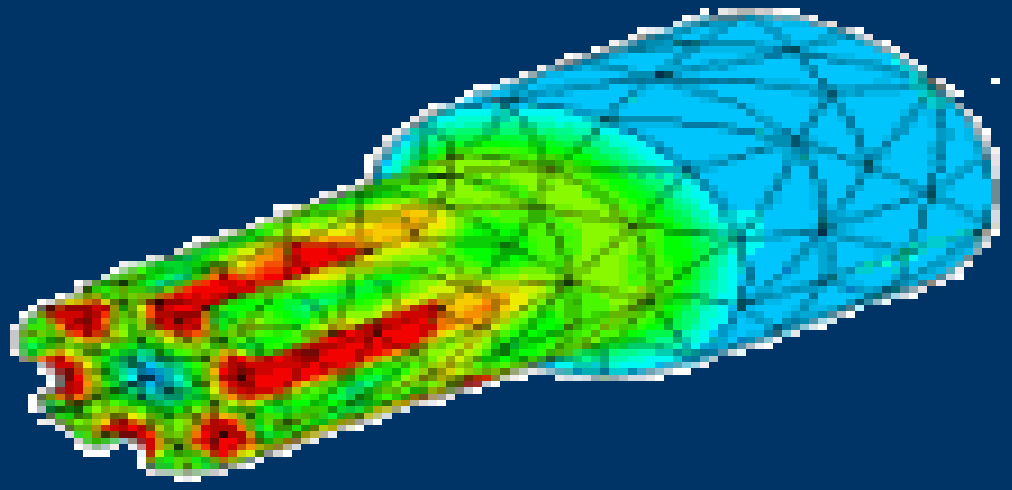
- Setting the type of analysis to be used
- Creating the model. The model is drawn in 1D, 2D or 3D space in the appropriate units (m, mm, in, etc..).
- Defining the element type, this may be 1D, 2D or 3D, and specific to the analysis type being carried out (you need thermal elements to do thermal analyses).
- Applying a Mesh. Mesh generation is the process of dividing the analysis continuum into a number of discrete parts or finite elements.

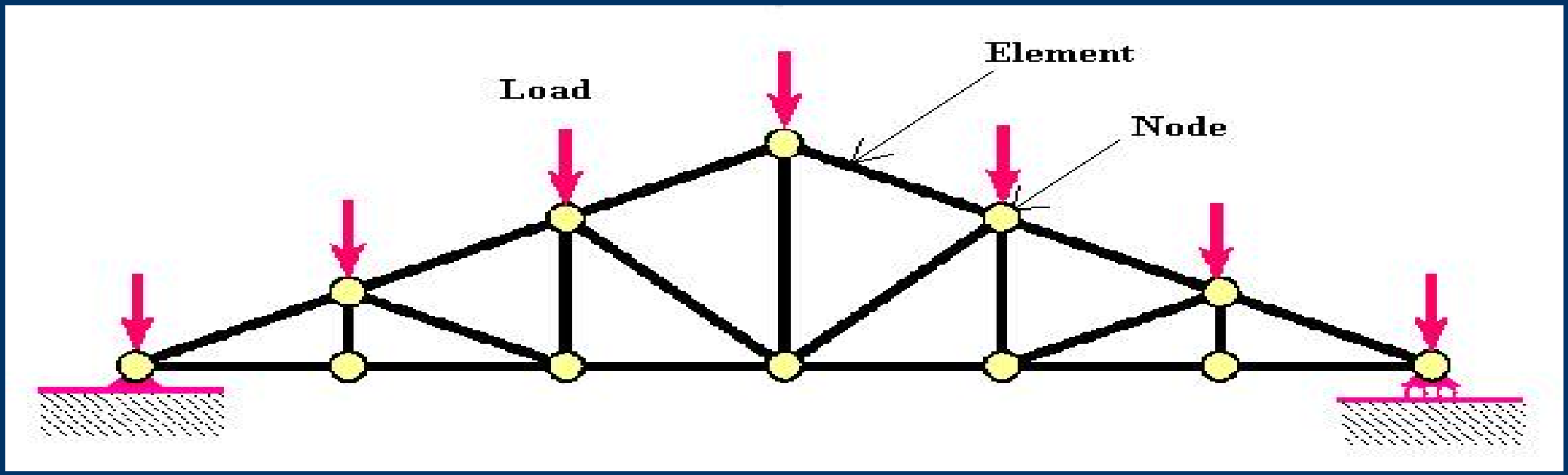
Trends – Elements



Trends – Mesh



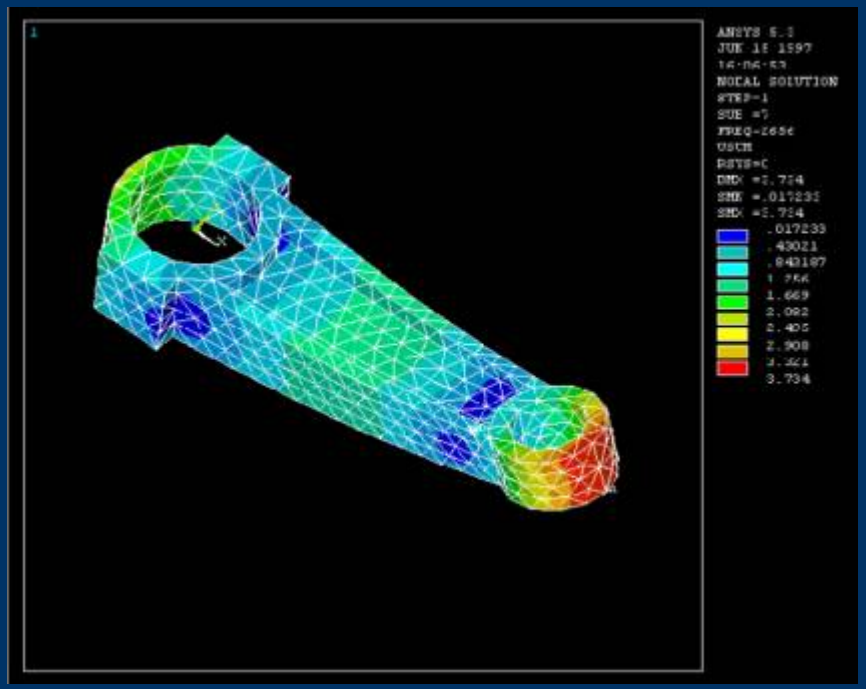




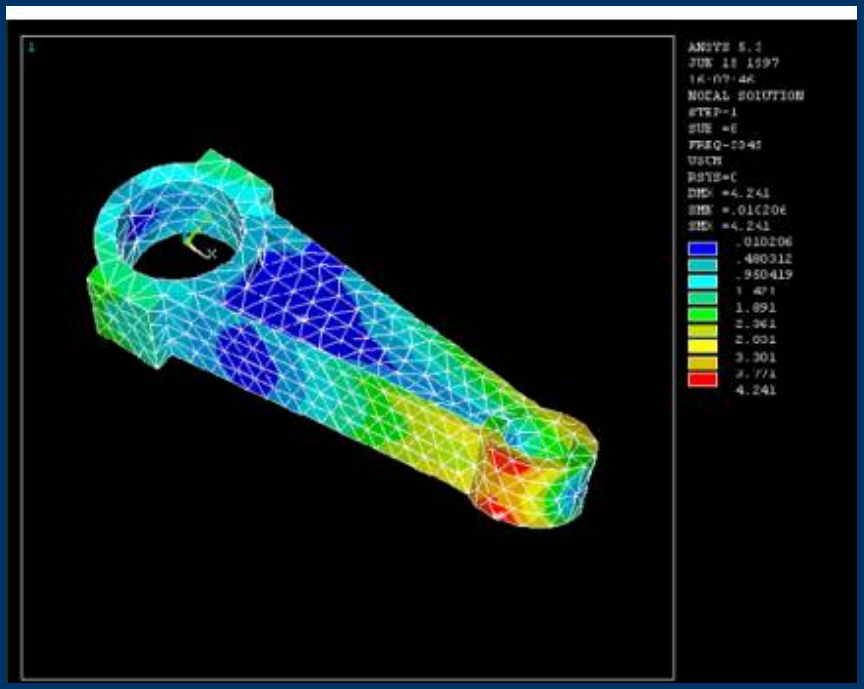
Trends – Example

- The Modal Analysis of A Connecting Rod

Bend



Twist



Summary

- The vast catalog of capability that comprises FEA, will no doubt grow considerably larger in the future.

- CAE is here to stay, but in order to harness its true power, the user must be familiar with many concepts, including the mechanics of the problem being modeled. All analyses require time, experience & most importantly, careful planning.