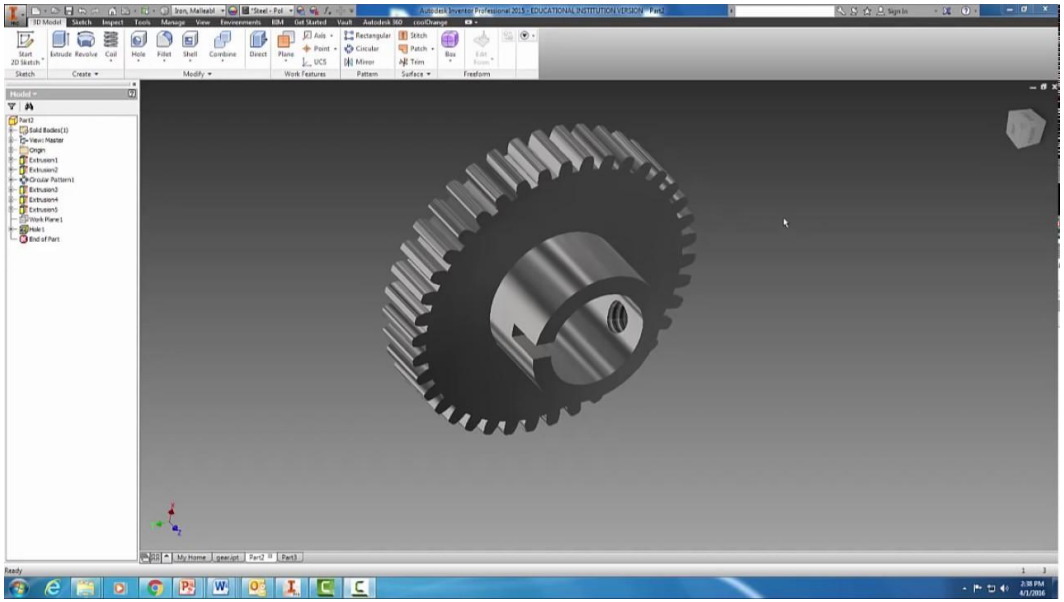

COMPUTATIONAL ANALYSIS
OF GEARS

INTRODUCTION TO GEARS

- Important rotating component of machines
- Used in power transmission systems
- Comprises of cut teeth on the edges
- Gear train – 2 or more gears working synchronously

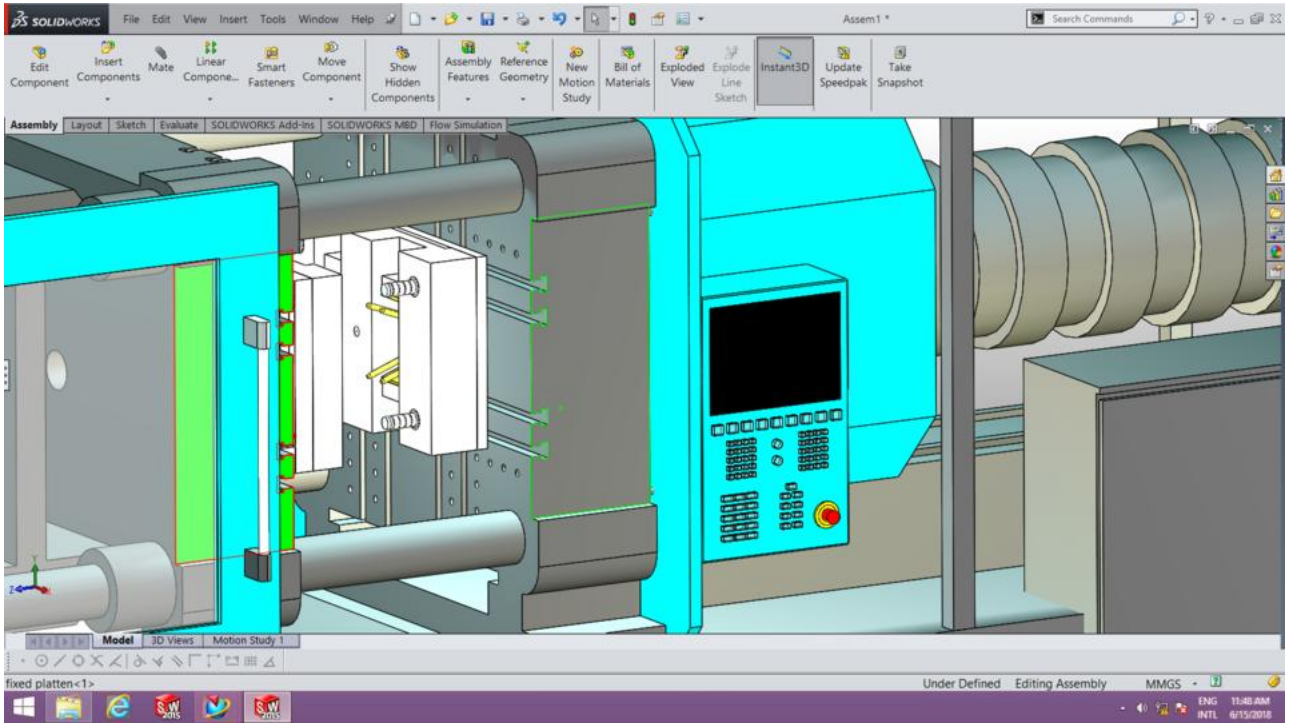
HISTORY OF COMPUTATIONAL EXAMINATION OF GEARS

- Manual drawings using drafting instruments
- Advent of computers brought with it interactive computer graphics
- Computer-Aided Design (CAD) for design, analysis, and simulation of engineering drawings in AutoDesk Inventor
- Provided 3D modeling capabilities

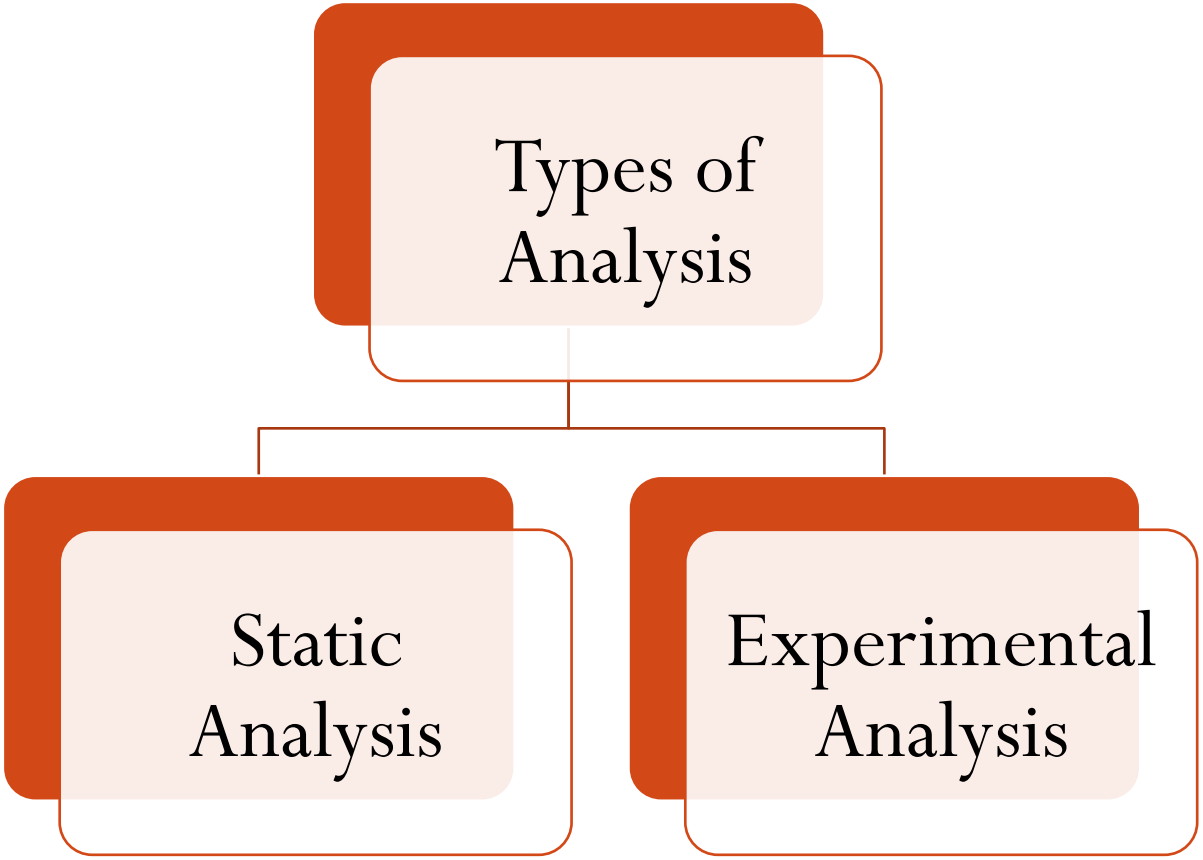


FUNCTIONALITIES OF COMPUTER SOFTWARE PROGRAMS

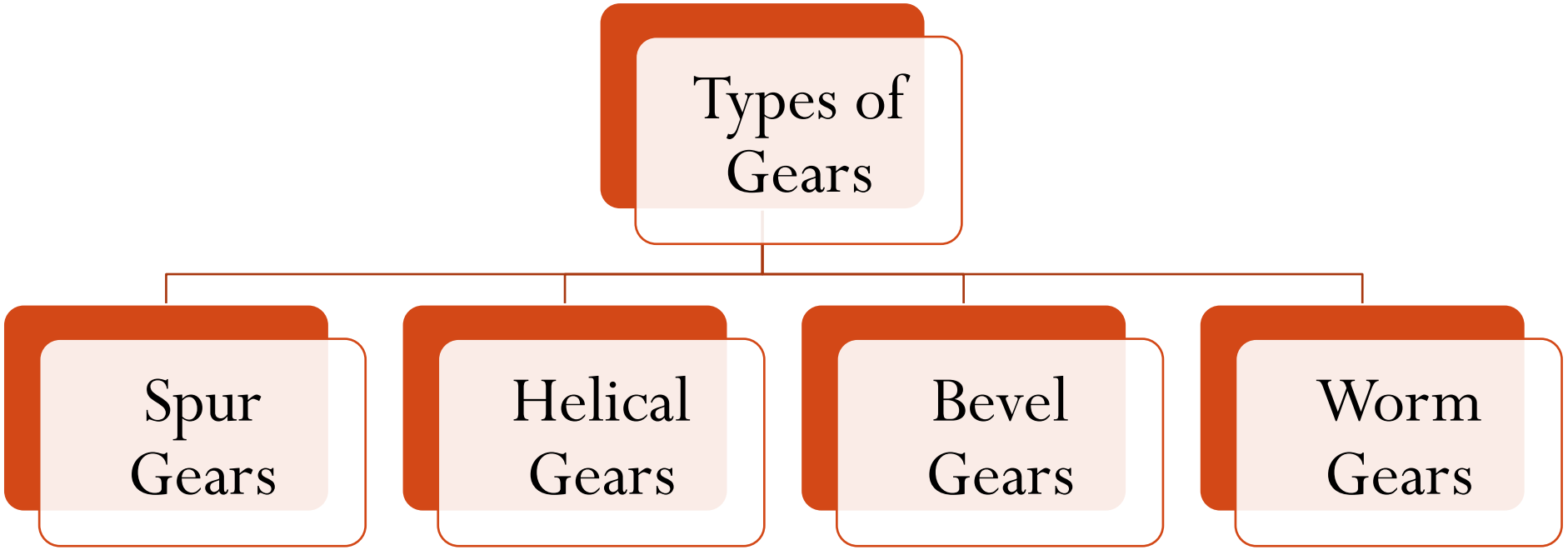
- Geometric modeling
- Engineering analysis calculations
- Automated testing
- Automated drafting



TYPES OF COMPUTATIONAL GEAR ANALYSIS



TYPES OF GEARS AND THEIR COMPUTATIONAL ANALYSES



COMPUTATIONAL ANALYSIS OF SPUR GEARS

- Most basic – Comprises of a radial disk with teeth
- An important parameter is strength of gear teeth
- Strength and rigidity of the shaft are also calculated
- Estimation of lifetime of bearings gives the durability of the system
- Other parameters to be considered – force analysis, bending stress of gear teeth, gear geometry

COMPUTATIONAL ANALYSIS OF HELICAL GEARS

- Used to carry heavy loads at high speeds
- High functional requirements, hence computational design and analysis is very critical
- Parameters to be considered – width of gear, length of teeth, load-carrying capacity, touch ratio, and operational capacity

COMPUTATIONAL ANALYSIS OF BEVEL GEARS

- Positioned at the intersection of two shaft axes
- Conically shaped gear teeth
- Straight or cylindrical bevel gears based on involute curvature
- Estimation of number of teeth required based on functional specificity

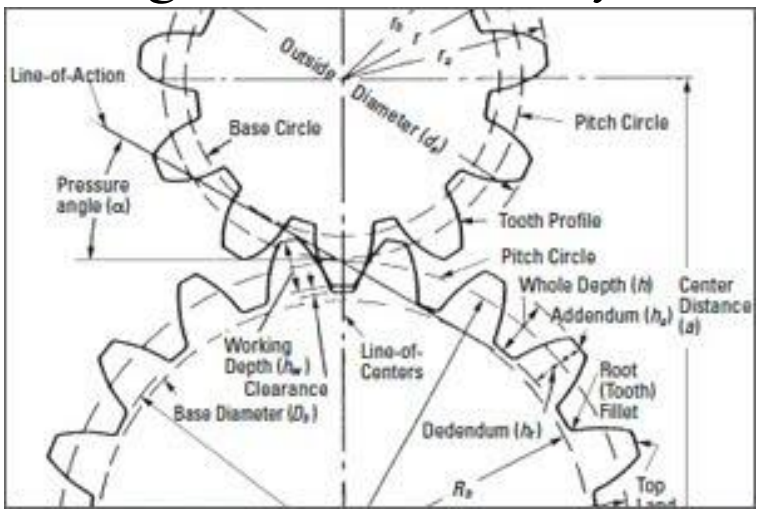
COMPUTATIONAL ANALYSIS OF WORM GEARS

- Used in cross-axes transmission systems
- Self-locking capabilities and high gear ratio
- Contact dynamics need to be accurately computed
- Generation motion between the cutter and gear is an important parameter
- Other parameters include pressure angle, axial module, number of teeth, and pitch diameter

FACTORS FOR COMPUTATIONAL ANALYSIS OF GEARS

Gear Geometry

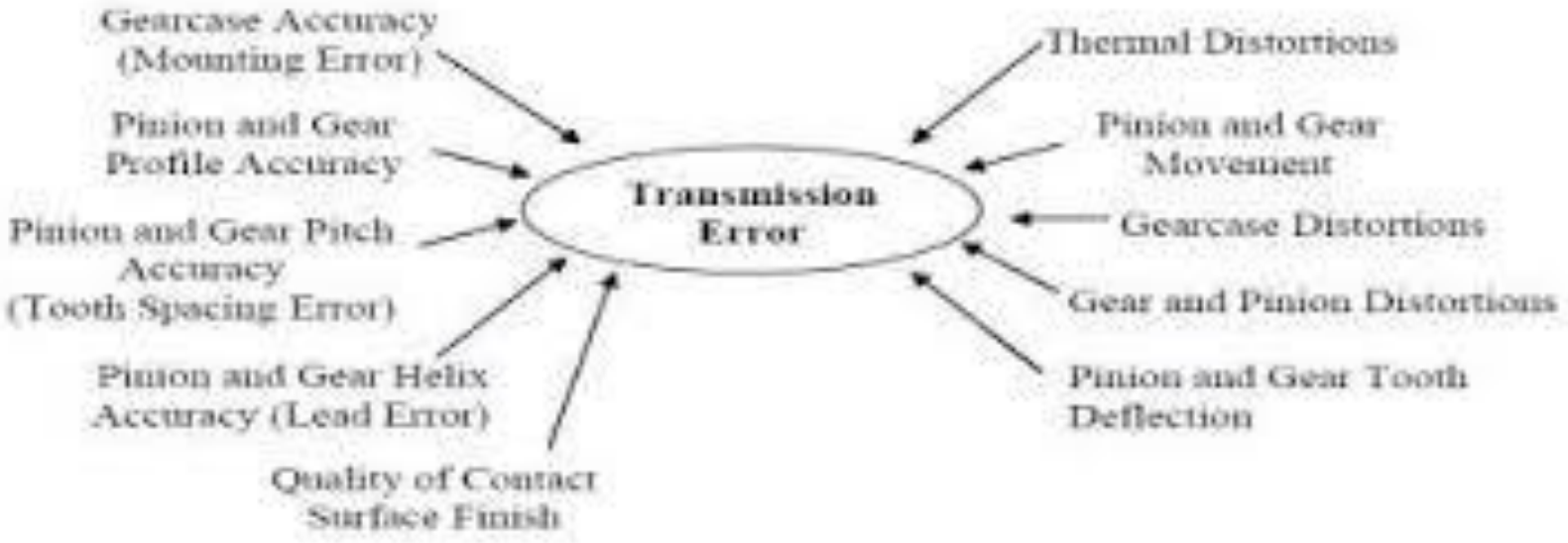
- Structural parameter
- Changes in gear geometry can lead to decrease in stress, transmission errors, and smoother operations
- Examples include size, shape, and radius of curvature
- Can be analyzed using Basic Geometry Theory



FACTORS FOR COMPUTATIONAL ANALYSIS OF GEARS

Transmission Error

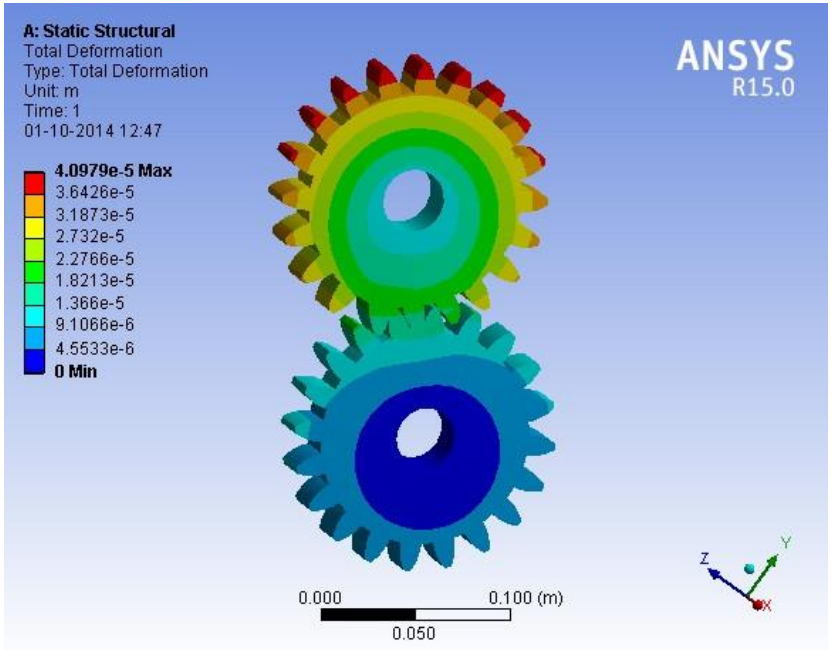
- Transmission error can cause noise and vibration in a machine
- Tooth profile modification can be used to reduce transmission error



FACTORS FOR COMPUTATIONAL ANALYSIS OF GEARS

Stress Analysis

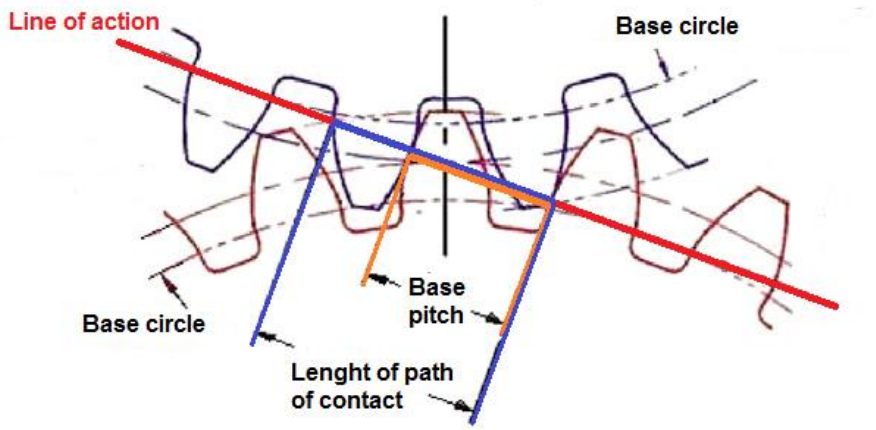
- Affects interlocking of gears in complex mechanisms
- A popular method is Finite Element Method (FEM)
- Symmetric and asymmetric profiles can be analyzed
- Cyclic Symmetry Concept



FACTORS FOR COMPUTATIONAL ANALYSIS OF GEARS

Contact Ratio

- Increase or decrease in contact ratio has serious consequences
- Positive consequences – introduction of compressive stress, lower bending in the system
- Negative consequences – increase in flash temperature, heat generation



FACTORS FOR COMPUTATIONAL ANALYSIS OF GEARS

Strength Calculation

- Automatic strength and kinematic calculation using software
- Modify structural aspects to achieve desired strength
- To achieve desired strength – programming using MATLAB or MathCad