An Introduction to Surface Texture

• **Product Implications (the function of surfaces)**
  o Load Carrying, Sliding, Sealing, Rolling, Appearance

• **Process Implications (the manufacture of surfaces)**
  o The material removal/modification process
    *Single-Point Processes, Milling, Grinding, Honing, Lapping, EDM, Plateau Honing*

• **The Graphical Representation of a Surface**
  o Aspect Ratio
    *Profile graphs vs. Microscope Images*

• **Measurement Methods (the specification and control of surface)**
  o From Fingernails to microscopes and Hockey Pucks to Laser Beams
  o Stylus-Based Measurement
    *Skidded and Skidless systems*
    *Advantages/Disadvantages*
  o Considerations when buying/using surface texture instrumentation

• **Wavelength Analysis & Filtering**
  o Example: Books on a Table
  o Separating roughness and waviness
  o Moving averages and the Gaussian Filter
  o The Filter “Cutoff”

• **Parameters**
  o Extreme Parameters (peaks and valleys)
    *Rp, Rv, Rt, Rpm, Rvm, Rtm, Rz*
  o Averaging Parameters
    *Ra, Rq, Rsk, Rku*
  o Slope/Spacing Parameters
    *Sm, Dq*
  o Bearing Ratio Parameters
    *Bearing Ratio Curve and analysis*
    *Htp*
  o Waviness and Form Parameters
An Introduction to Surface Texture (continued)

Special Topics in Surface Texture Measurement and Analysis:

Note: these are not covered during the basic class, but can be address offline or through custom training.

Repeatability/Uncertainty of surface measurements
Comparison of various national and international standards
Testing/Calibration of surface texture instruments
Going beyond roughness and waviness
    Wear Analysis, Geometry Measurement, Profile Tolerances, etc.
Research trends in surface metrology
ISO 13565-1
    Valley suppression filtering
ISO 13565-2
    Rk, Rpk, Rvk, RMr1, RMr2
ISO 13565-3
    Rpq, Rvq, Rmq
Measurement and Specification for Plateau Honing
Measurement and Specification for Sealing Surfaces
    Bandpass Waviness
Advanced Filtering Topics
    Types: (ISO, 2CR, 2RC, PC, Gaussian, Spline)
    Phases & Transmissions
Other topics of interest
An Introduction to Roundness

- **Product Implications (the functional aspects of roundness)**
  - Fitting, Rotating, Sealing, Rolling, Interfaces
    - *Roundness vs. Cylindricity*
    - *Chatter and vibration*

- **Process Implications (relating to roundness)**
  - Boring, turning, reaming, grinding, honing, lapping, superfinishing/microfinishing, drilling, etc.
  - Spindle Errors, Vibration, Structural Implications, Chucking of thin-walled components
    - *Chatter & Lobing*

- **Measurement Methods for Roundness**
  - Measurement of Multiple Diameters
    - *Ovality vs. Roundness*
  - V-Block Methods
    - *Angle vs. Lobing Implications*
  - Rotation on Centers
  - Polar (Spindle-based) Instruments
    - *Centering and Leveling*
  - Considerations when buying/using roundness instrumentation
    - *Probe Alignment Issues*

- **Frequency Analysis and Filtering**
  - Example: Roundness of a U.S. Quarter
    - *Including or excluding the serrations*
    - *The tip radius/surface interactions*
  - “Harmonic” or “Fourier” analysis.
  - Moving Averages and the Gaussian Filter
  - The filter “Cutoff”

- **The Roundness Value**
  - ASME Y14.5 Definition
  - Reference Circles
    - *LSC, MZC, MIC, MCC*
    - *GD&T Standards vs. Metrology Practice*
  - Additional Parameters
    - *Eccentricity, Concentricity, Runout*
  - Related Parameters
    - *Circular Flatness, Perpendicularity, Tilt, Face Runout*
    - *Cylindricity*
An Introduction to Roundness (continued)

Special Topics in Roundness Measurement and Analysis:

Note: these are not covered during the basic class, but can be address offline or through custom training.

Repeatability/Uncertainty of surface measurements
Accuracy Improvement through reversal
Chatter analysis via “brick-wall” filtering
Circumferential Wear Analysis
Cam Lobes and Lift Profiles
Outlier detection and removal
Dealing with discontinuous surfaces or partial arcs.
Sector Roundness and conformable interfaces
Cones and conicity
Tip Radius and Filter Cutoff Selection
Advanced Filtering Topics
   Types: (ISO, 2CR, 2RC, PC, Gaussian, Spline)
   Phases & Transmissions
Other topics of interest