A SYSTEM FOR GEOMETRY-BASED ARCHIVAL AND RETRIEVAL OF DESIGN INFORMATION FOR MECHANICAL PARTS

CECD
CENTER FOR ENERGETIC CONCEPTS DEVELOPMENT

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Motivation

- Many organizations use 3D CAD systems and archive geometric information for mechanical parts
- Currently archived geometric information is accessed *manually* for use in future projects
  - » Existing search methods for text or file name searches do not work on geometric information

Currently searching for geometrically similar parts can take hours! → Increased product development time and cost

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Goals

- Create a software system that-
  - » Locates geometrically similar parts in a database of mechanical parts in less than one minute
  - » One does not require to remember project names and file names to perform part search
  - » Supports many different ways to archive and retrieve geometric information for a wide variety of applications
  - » Has an open architecture that allows extensions to the system capabilities based on new needs

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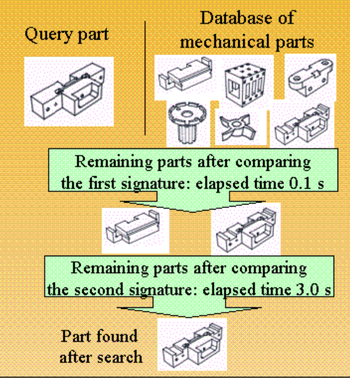
Our Approach

- Develop appropriate shape signatures for archival and retrieval
- Utilize multiple signatures for
  - » Better discrimination
  - » Improved computational performance
  - » Different applications



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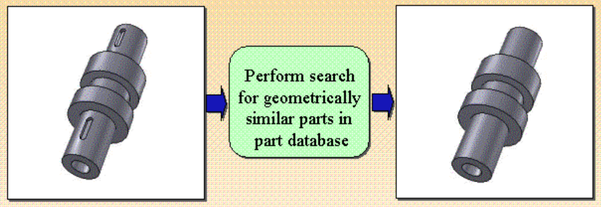
Application 1: Part Reuse to Reduce Part Proliferation



New part can be produced by cutting two slots in the existing part → Reduction in manufacturing and inventory cost

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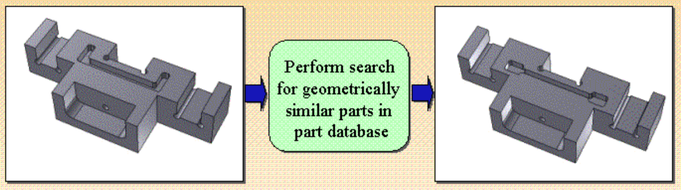
Application 2: Subcontractor Selection



Select the subcontractor for the new part based on subcontractor for the existing part → Significant reduction in part procurement time and cost

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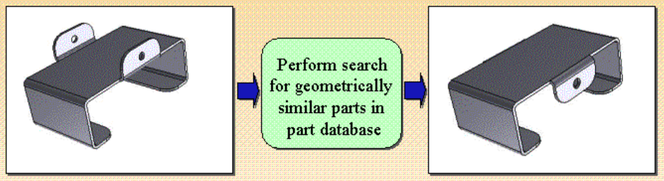
Application 3: Cost Estimation



Develop cost estimate for the new part based on the cost estimate of the existing part → Significant reduction in cost estimation time

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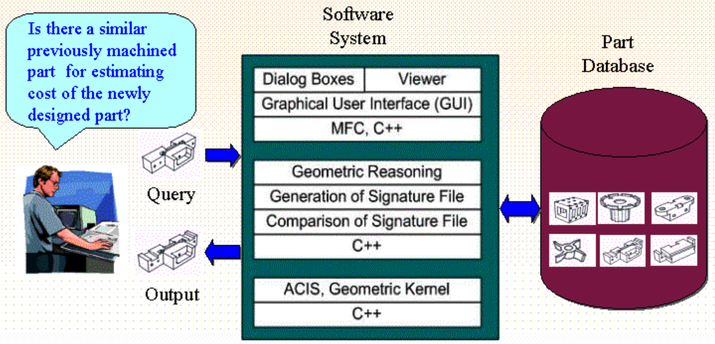
System Architecture



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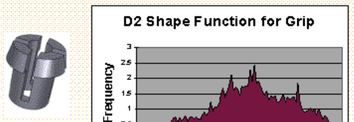
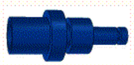
Currently Available Signatures for Archival and Retrieval

- Signatures
  - » Rotational
  - » Shape function based on
    - – D1, D2, and D3 shape functions
  - » Convexity based on
    - – Hull volume and area ratio
    - – Curvature distribution
  - » Surface parameters based on
    - – Area and depth histograms
    - – Area distribution
    - – Plane orientation
    - – Surface type





Hull Volume Ratio = 2.3581

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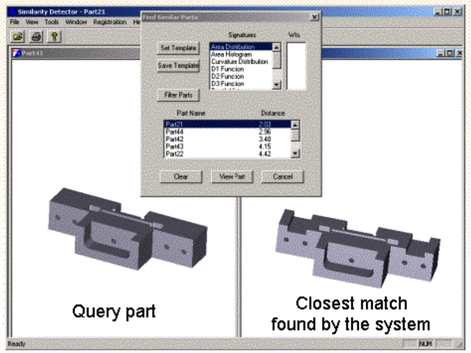
Example



- Database Size: 60 parts
- Signature Used: Area Distribution
- No. of Similar Parts Found: 7
- Time Taken = 2.1 sec

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