Introduction to STEP-NC

Explicit Toolpaths

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Overview

• Toolpaths allow us to capture exact machine axis movements.
  – Workplan still has feature and operation-oriented plan.
  – Captures a detailed motion plan for particular operations.
  – More flexible to give a controller an operation plan and let it generate the motion plan itself.

• Question
  – What types of tool paths can we specify?
  – How are they represented in the AIM?
  – How are they attached to an operation?
• Used for explicit control of the tool movement
  – Not needed if controller can do its own path planning.
  – Might be used to capture optimized paths or to transition from existing processes.

• Reduces the flexibility of STEP-NC workplans
  – However, paths could be stripped out and regenerated
  – Defining the “how”, but the “what” is still there
STEP-NC Toolpaths

- toolpath
  - parameterised path
  - trajectory
  - feedstop
    - cutter location
    - cutter contact
    - axis
      - approach lift path
        - A/L angle
        - A/L tangent
      - connector
        - connect secplane
        - connect direct

Dwell at a particular location

Movements following explicit curves with respect to certain reference points

Movements generated by the controller using certain parameters
• Trajectories provide a bounded curves for the tool to follow through space.

• Exactly how the tool follows the curve depends on which type of trajectory you use

• trajectory
  – cutter_location_trajectory  motion of tool tip
  – cutter_contact_trajectory  contact point on workpiece
  – This is machine independent. The new benefit is a standard way to exchange TCP descriptions.

  – axis_trajectory  each axis separately
  – This is machine dependent, but does enable transition from old-style existing procedures.
Parameterized Paths

• Intended for use with cutter contact strategies
  – Cutter contact strategies describe motion on the workpiece but you may not know the absolute cutter position at the end
  – Need a way to describe the approach and connect moves parametrically

• parameterised_path
  – approach_lift_path
    » ap_lift_path_angle
    » ap_lift_path_tangent
  – connector
    » connect_secplane
    » connect_direct
• Two types of approach and lift paths are available

Linear with angle

Tangential
Connectors

• Two types of connect paths are available

• Direct
  – Tool moves in a straight line from the end of one operation to the beginning of the following one

• Via security plane
  – Tool moves in a particular direction up to the security plane
  – Then to the new location
  – Then down to the next start point in a particular direction
Toolpath AIM Representation

- Toolpaths represented as action methods
- Related to operation with a sequential method relationship subtype.
- Curves and parameters as action properties
Same technique used to order workingsteps within a workplan.

**machining_toolpath_sequence_relationship**
has a sequence number used to establish ordering
(subtype of action method relationship & sequential_method)
Summary

• Toolpaths allow us to capture exact tool motion.
  – Workplan still has feature and operation-oriented.
  – Captures a motion plan for a particular operation.

  – More flexible to give a controller a operation plan and let it generate the motion plan itself.
  – Motion plan can be described either as:
    » tool motion (machine independent, the new benefit)
    » axis motion (old-style, machine dependent, to enable transition from existing procedures)