

Introduction to **STEP-NC**

Explicit Toolpaths

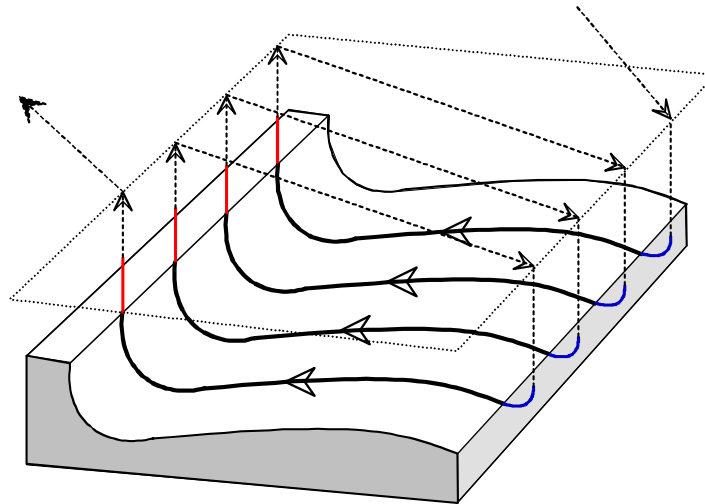
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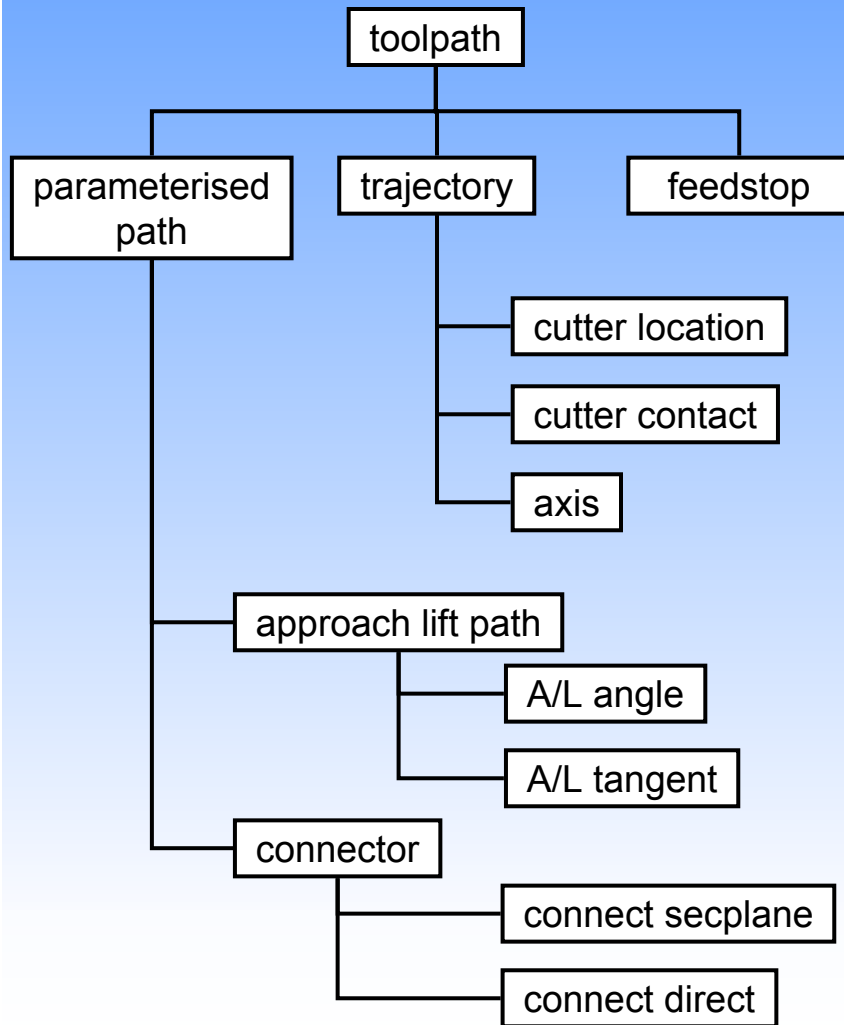
- **Toolpaths allow us to capture exact machine axis movements.**
 - Workplan still has feature and operation-oriented plan.
 - Captures a detailed motion plan for particular operations.
 - More flexible to give a controller a operation plan and let it generate the motion plan itself.

- **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



Dwell at a particular location

Movements following explicit curves with respect to certain reference points

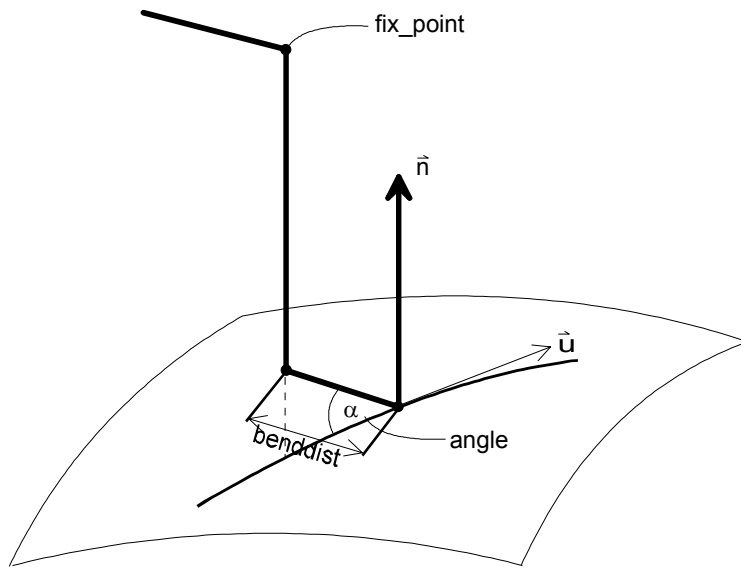
Movements generated by the controller using certain parameters

- 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.

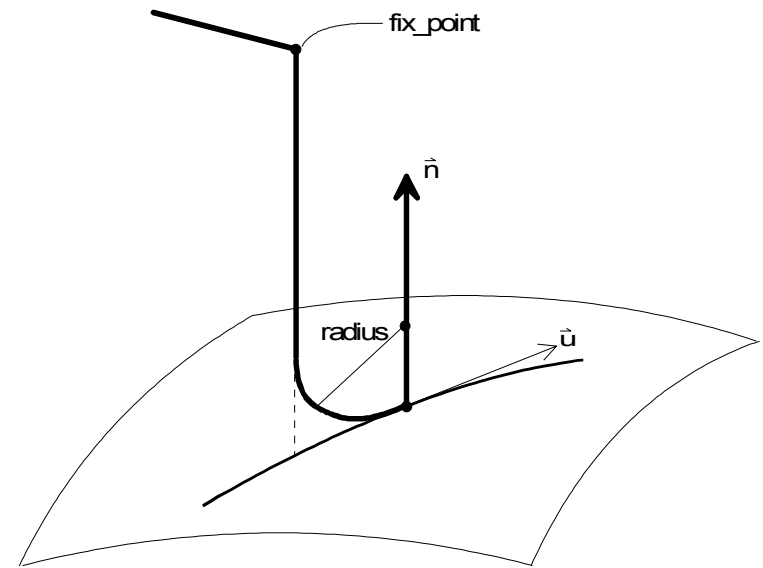
- **Intended for use with cutter contact strategies**
 - **Cutter contact strategies describe motion on the workpiece but you may not know the absolute cutter position at the end**
 - **Need a way to describe the approach and connect moves parametrically**

- **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

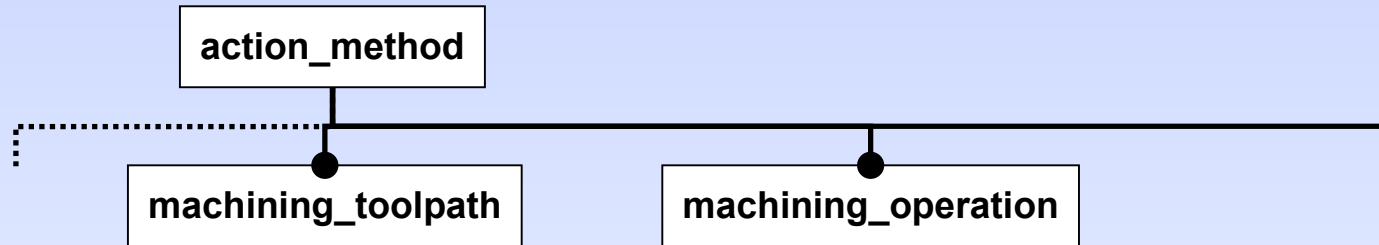


Linear with angle

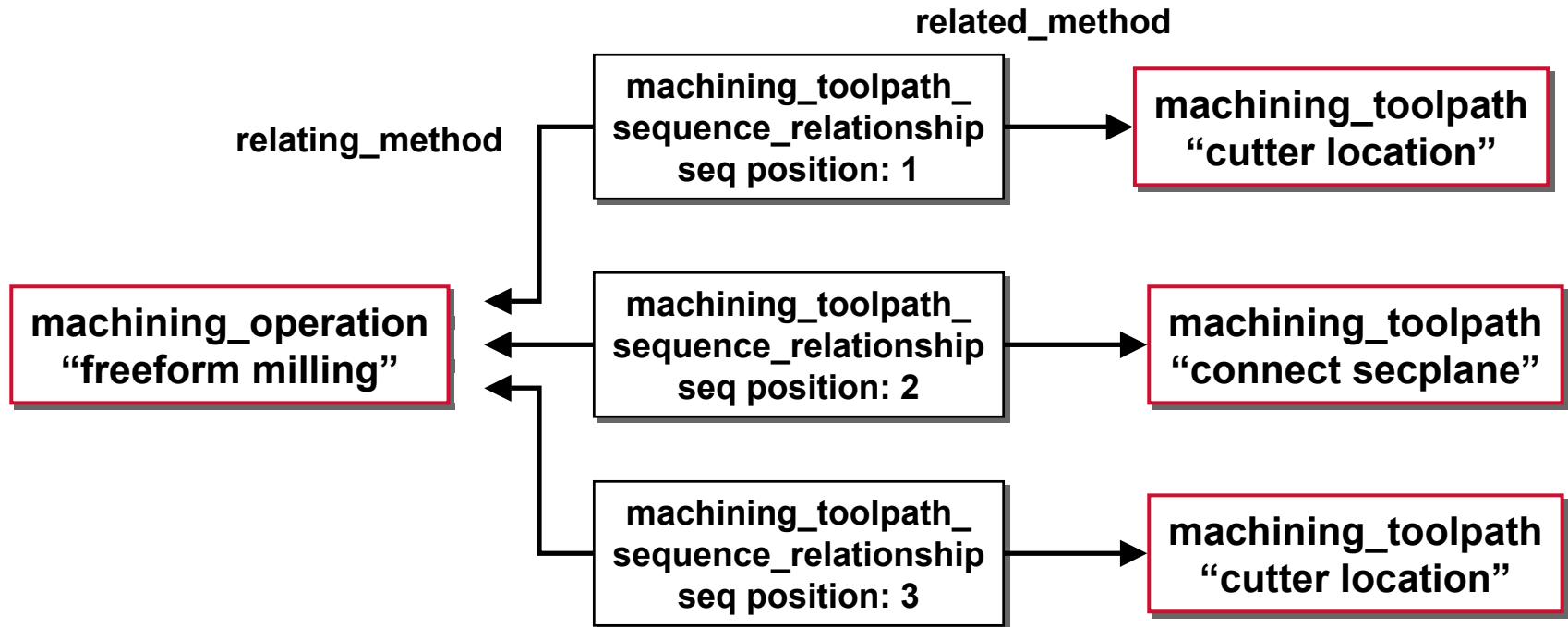


Tangential

- **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



- 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)

- **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)**