**Document Control Sheet**

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| 4. author(s) (family name, first name(s))  Damtew, Lionel  Schneider, Claudius  Dr. Plakhotnik, Denys  Mike, Brinkmann | | | 5. end of project  30/06/2024 |
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| 18. abstract  1. the current state of science and technology is that tool paths must be calculated mathematically. A separate command must be written for the CNC machine for each angle and feed rate, and each entry and exit path and speed, etc.  2 The objective of the development was to greatly simplify the programming process with AI support. In a VR environment, the programmer should generate tool paths through intuitive gestures using a tracked input pen. These are then interpreted in a subsequently calculated voxel representation by artificial intelligence and written into a program code.  3. The VR application developed uses a 3D screen (VR PluraView) with an integrated infrared camera for stereoscopic representation of the workpiece and the tool. Using a specially developed tracking pen (CAMStylus), which simulates the function of the tool, the gestures can be recorded in this VR environment. The recognized positions and orientations of the CAMStylus are displayed in real time in the VR application so that the user receives direct feedback on the gesture entered. This data is then converted into a voxel representation for downstream calculations. Using artificial intelligence, key features of the gesture are recognized from this voxel representation and CAM parameters are calculated that correspond to these recognized features. In the next step, the CAM parameters are used to calculate a tool path that has these recognized features. This toolpath can then be used as in conventional CAM systems to simulate, study and actually perform the process.  4. result: The feasibility of the project was demonstrated by initial tests during the milling of free-form surfaces from toolmaking. The virtual reality system, consisting of the VR PluraView and the wireless CAMStylus tracking pen, was successfully implemented. Essential features of the input are recognized with sufficient accuracy so that these features can be used to generate the tool path. As a result, the calculated tool path is very similar to the input gestures in most cases. In further tests, the developed solution has already been used to plan the finishing operations for complex components by intuitive sketching and to manufacture a component.  5 The VR hardware developed to implement the project, consisting of the wireless CAMStylus for inputting gestures and the VR PluraView for visualizing the 3D working environment, can be considered ready for series production. For productive use of the project approach, it is necessary to extend the scope to a wider range of machining strategies. | | | |
| 19. keywords  Tool path, programming, CAM parameters, CAM system, AI support, stylus, tracking, intuitive, gesture, CAMStylus, VR PluraView, infrared tracking camera, VR environment, voxel display, artificial intelligence, 3D screen | | | |
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