عنوان مقاله:

Feasibility Study on Design and Development of a Hybrid Controller for Ultra-Precision Single-Point Diamond Turning

محل انتشار:

مجله مهندسی برق مجلسی, دوره 13, شماره 2 (سال: 1398)

تعداد صفحات اصل مقاله: 8

نویسندگان:

Shahrokh Hatefi - *Department of Mechatronics, Nelson Mandela University, South Africa*

Khaled Abou-El-Hossein - *Department of Mechatronics, Nelson Mandela University, South Africa*

خلاصه مقاله:

The recent realm and leader technology in advanced manufacturing of critical components, and optical surfaces is ultra-precision Single-Point Diamond Turning (SPDT). This state-of-the-art technology enables machining optical surfaces with nanometric accuracies and surface roughness from order of nanometers. However, there are drawbacks in this process and SPDT is limited when machining brittle- and difficult-to-cut materials. Non-conventional assisted technologies have been developed and used to assist SPDT for extending turning limitations. Recently, application of novel hybrid platforms for SPDT has been emerging to achieve the best possible outcome in optical surface generation. Hybrid controllers are playing the main role in a hybrid platform. Main tasks of a hybrid controller in a hybrid SPDT platform include; real-time assisted technologies performance control, setting working parameters, and effective communication with implemented sensors for on-machine metrology. Hybrid processes in SPDT are recently emerging and there have been a few studies on designing and developing such novel platforms for SPDT. The purpose of this study is to design and simulate a Multi-Axis Automatic Hybrid Controller (MAAHC) to be used in a hybrid platform for assisting SPDT technologies. MAAHC has three process cores which work independently and communicate simultaneously. The designed MAAHC has different capabilities; MAAHC can control and drive ultrasonic vibration system, laser beam system, cold plasma system, and on-machine metrology systems i.e. vibration and force sensors. In addition, MAAHC is capable to control and drive two stepper motors in two independent linear axes. Electronic switches, communication ports, and high-performance switching have provided a full control on secondary technologies assisting in realizing a hybrid SPDT platform. Theoretical equations, design specifications, and simulation results have revealed that the proposed MAAHC is functional and has met all requirements to control such a hybrid SPDT process.

کلمات کلیدی:

hybrid controller, Ultra-Precision Machining, Single-Point Diamond Turning