Optimization of Bulged Precessing Tool Polishing for Efficient Mass-Fabrication of Large Optical Surfaces

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Abstract: The progress in optimization technique for the bulged precessing tool polishing is reported. The technique uses a unique algorithm for the active modulation of polishing variables and tool-paths. The simulation details and results are presented.

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1. Introduction

The Computer Controlled Optical Surfacing (CCOS) has been successfully used for fabrication of large aspheric optical surfaces, including off axis segments [1-3]. The bulged precessing polishing process is regarded as one of the latest developments in the CCOS technique [4]. It offers much greater improvement in three elements, i) low tooling overhead, ii) deterministic material removal and iii) embedded process control intelligence [5]. The recent application of this technique showed the deterministic controllability in material removal from axially non-symmetric optical surfaces [6]. Nevertheless, the need for further process development is well addressed for mass-fabrication throughput requirements for the ELT projects currently being discussed world-wide [5].

2. Polishing simulation with optimization technique

We will first report the theoretical foundation and the experimental verification of the bulged precessing tool polishing. This will be followed by the polishing simulation strategies utilizing the 7 axis CNC machine base [6] and the swing-arm machine base [7]. The optimization technique for control variables will then be discussed based on the discrete (point-to-point) and continuous tool motions. This includes the active modulation of the machine parameters and tool paths in view of minimization of the tool marks and edge effects on the work piece surface. The technical details of the polishing simulations for removal of axially non-symmetric form errors from a 2m class hexagonal segments and a circularly symmetric work piece will be presented. The resulting surface form errors together with the evolution of primary polishing variables during fabrication simulation demonstrate that the mass fabrication throughput requirements for the ELT projects can be successfully met with the deterministic material removal of the bulged precessing tool polishing.

3. References

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