

Development of Linear Interpolation Technique for Nanoposition control Using Analog Encoder Signal

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I. INTRODUCTION

Recently, the resolution of nanoposition is rapidly advanced with nanotechnology. So, we intend to propose a novel method with simplified technique for signal interpolation. Already, various interpolation methods based on the quadrature signal have been applied to the precision servo system [1-3].

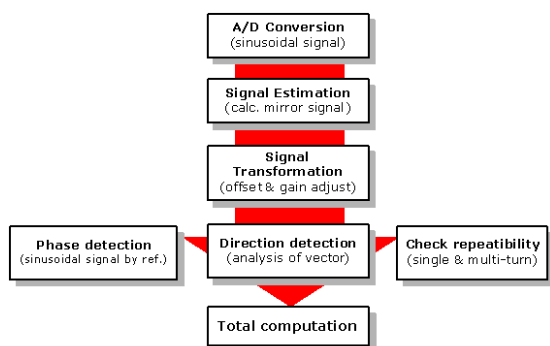


Fig. 1 Procedure of the interpolation algorithm

The proposed interpolation algorithm consists of three steps as Fig.1. First, we transform encoder signals with analog type. Second, we determine the quadrant in sign condition and extract linear parts in analog signal. Last step, we compute totally real movement by obtained information and length-unit transformation. All the process is simulated by Matlab simulink as Fig.2 ~3.

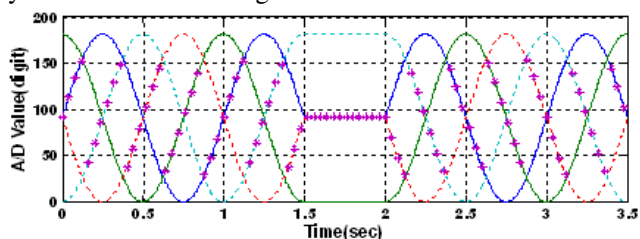


Fig. 2 Trajectory of sinusoidal signal to interpolate

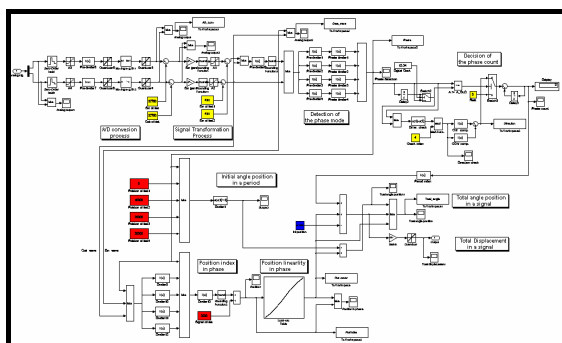


Fig. 3 Simulation with Matlab simulink[®]

II. EXPERIMENTAL RESULTS

To verify the proposed interpolation algorithm, We have implemented nano-based movement of XY-stage which comprise two PM type stepper motors, coupling and cross-roller guide stage, driven by microstepping with MSR(micro step ratio) and compared with laser interferometer. As a result, we obtained the resolution of 20.8nm shown in Fig. 4.

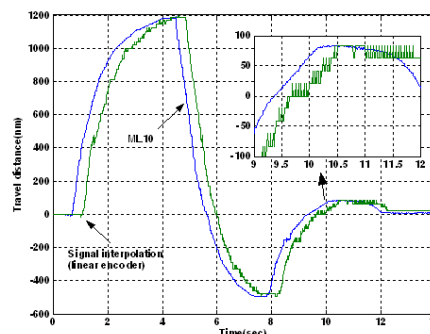


Fig. 4 Result of position control by MSR

After that, we have implemented the micro-based scratch movement on the silicon wafer(4 inch), using diamond tip as shown Fig. 5

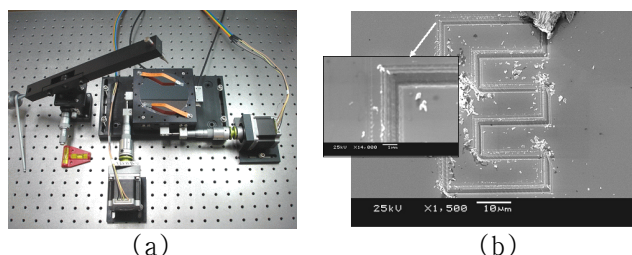


Fig. 5 Comparison of measurement results : (a) Experimental appar. on optical table, (b) SEM images

III. Conclusion

We proposed the simplified interpolation algorithm without the arctangent operation and verified it by experiments with Laser interferometer.

References

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