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White Light Channeled Spectrum Interferometry for the On-line Surface Inspection

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Aim

This research project aims to explore an environmentally robust surface measurement system for on-line surface inspection by using cylindrical lenses based **White Light Channeled Spectrum Interferometry** (WLCSI) , and to realize large dynamic measurement ratio with a high signal-to-noise ratio.

Introduction

The rapidly developing industries such as MEMS, micro fluidics, photovoltaic thin film, Si wafers and hard disks critically rely on micro/nano scale and ultra-precision structured surfaces.

The proposed WLCSI in this research project is effective for applications in on-line surface inspection because it can obtain a surface profile in a single shot. It has an advantage over existing spectral interferometry techniques by using cylindrical lenses as the objective lens in a Michelson interferometric configuration to enable the measurement of long profiles.

Experimental setup

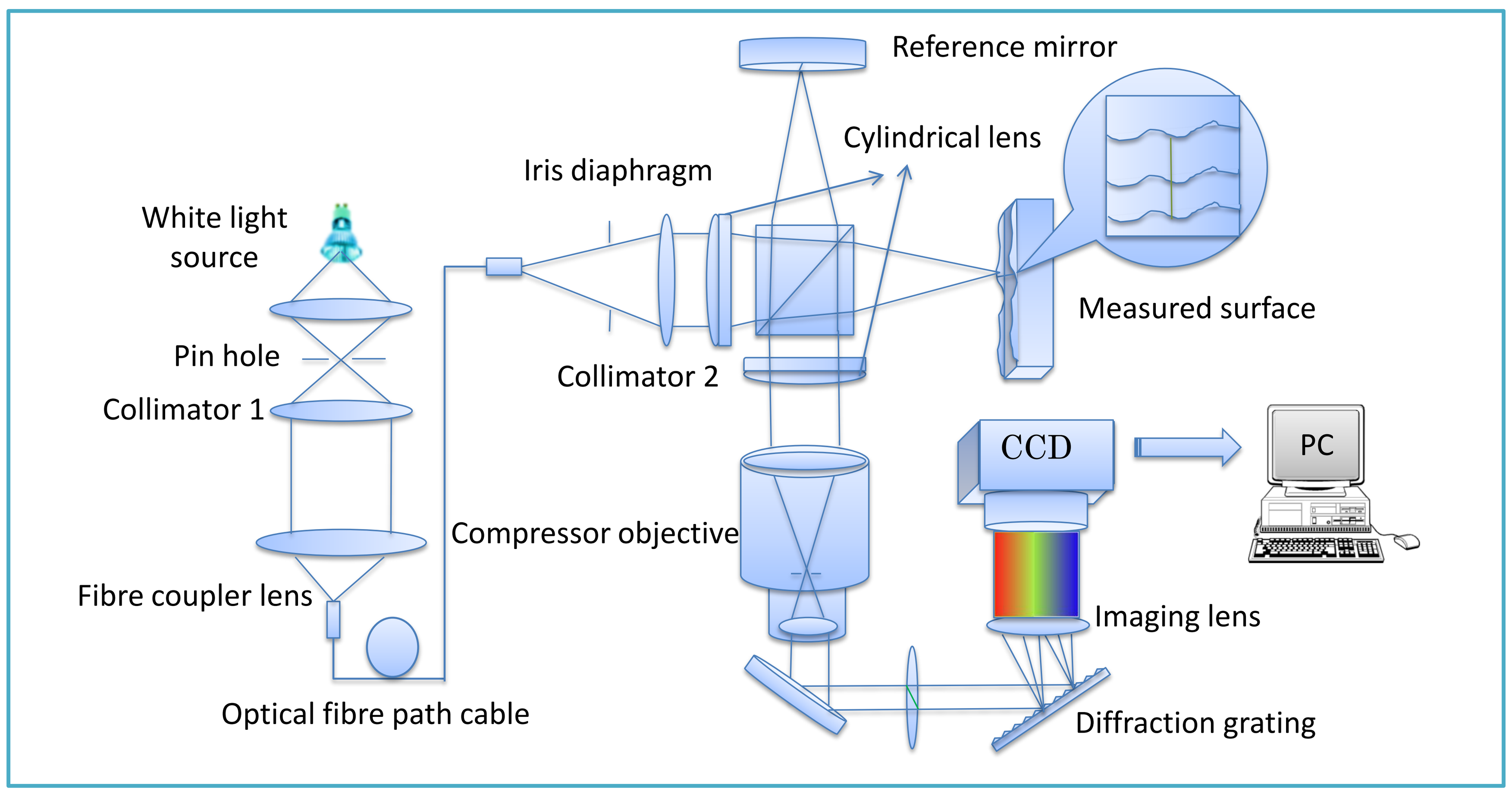

Fig. 1. Schematic diagram of WLCSI

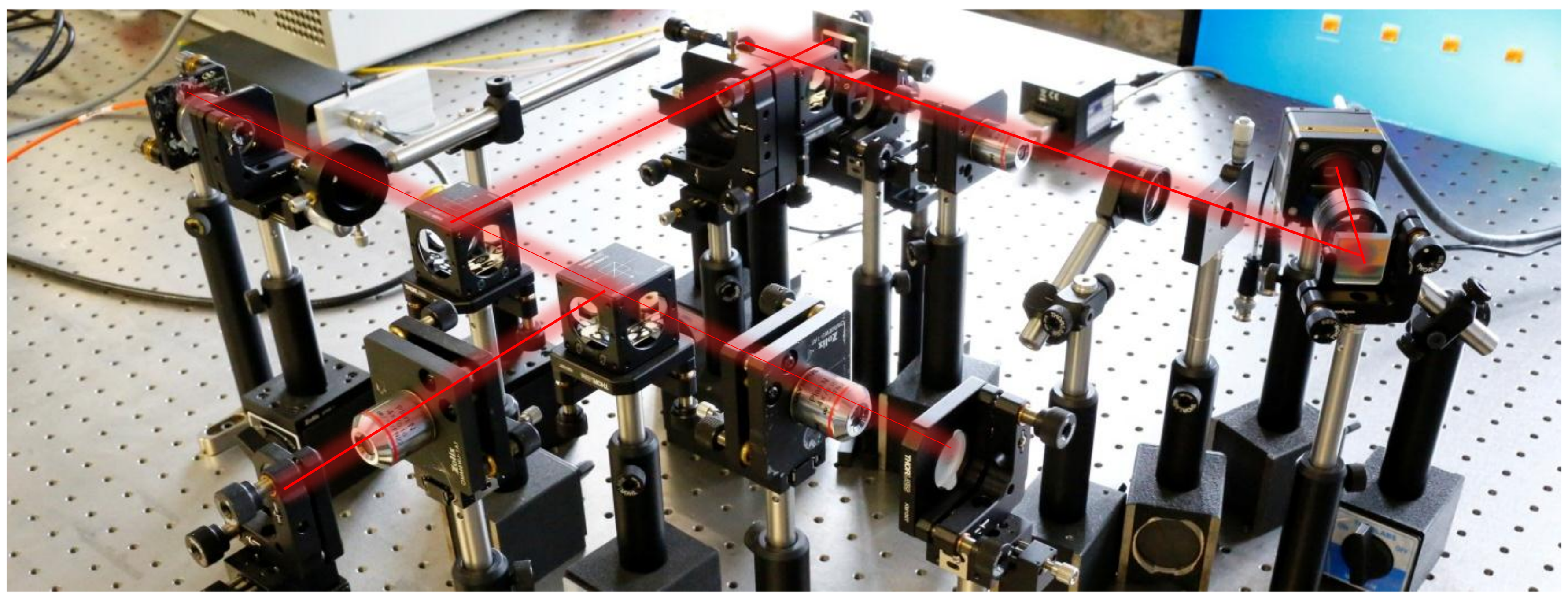

Fig. 2. Experimental optical setup

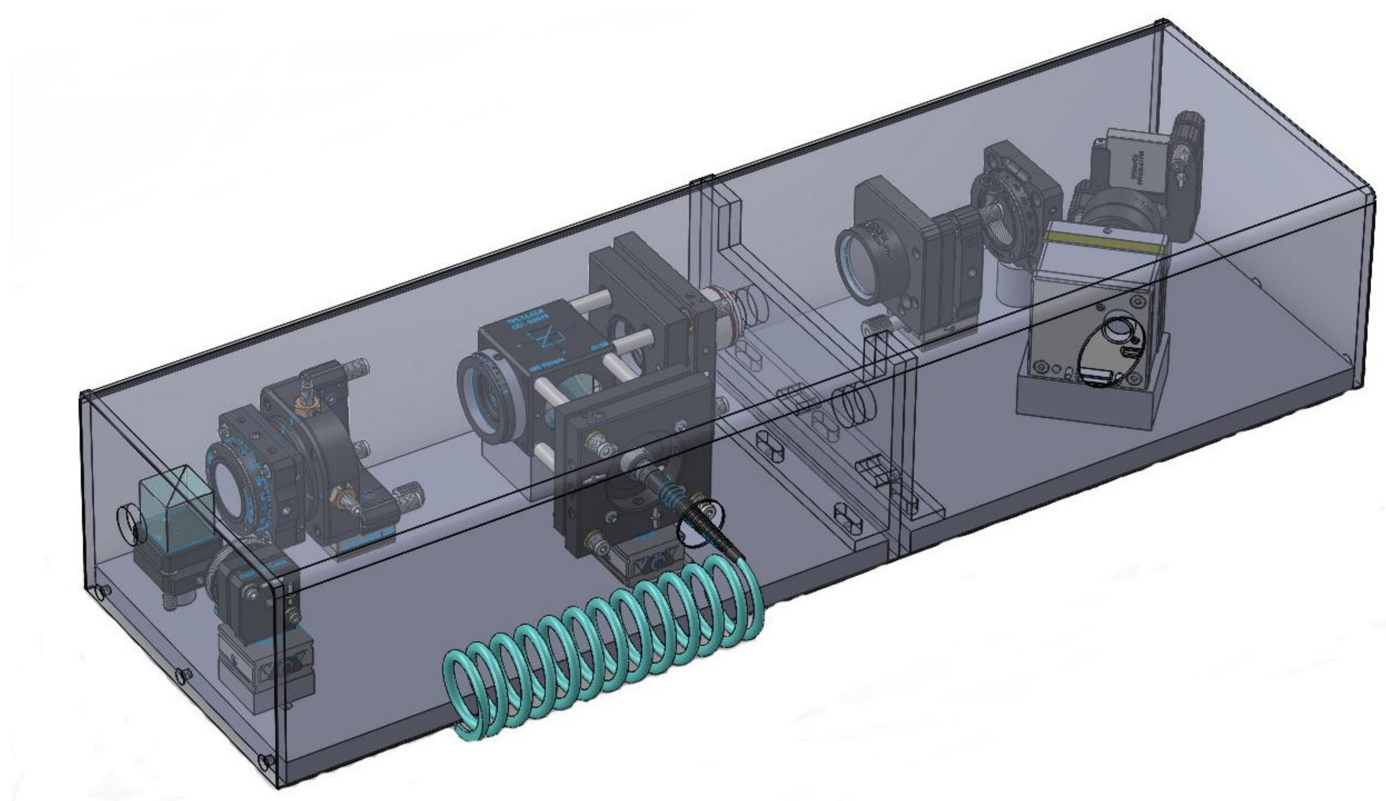

Fig. 3. Designed prototype of WLCSI

Optical simulation

The WLCSI was modeled using Zemax software to get better understand the influence from the alignment errors.

- Tilts of cylindrical lens (CY) only lead to the deformation of the line focusing beam on the tested surface.
- Tilts of the beamsplitter (BS) will lead to a tilt of the optical axis and thus the light beam will no longer travel on the same path, which in this case straight fringes with equal interval are generated on the image plane.
- BS is much more sensitive to the tilt than CY.

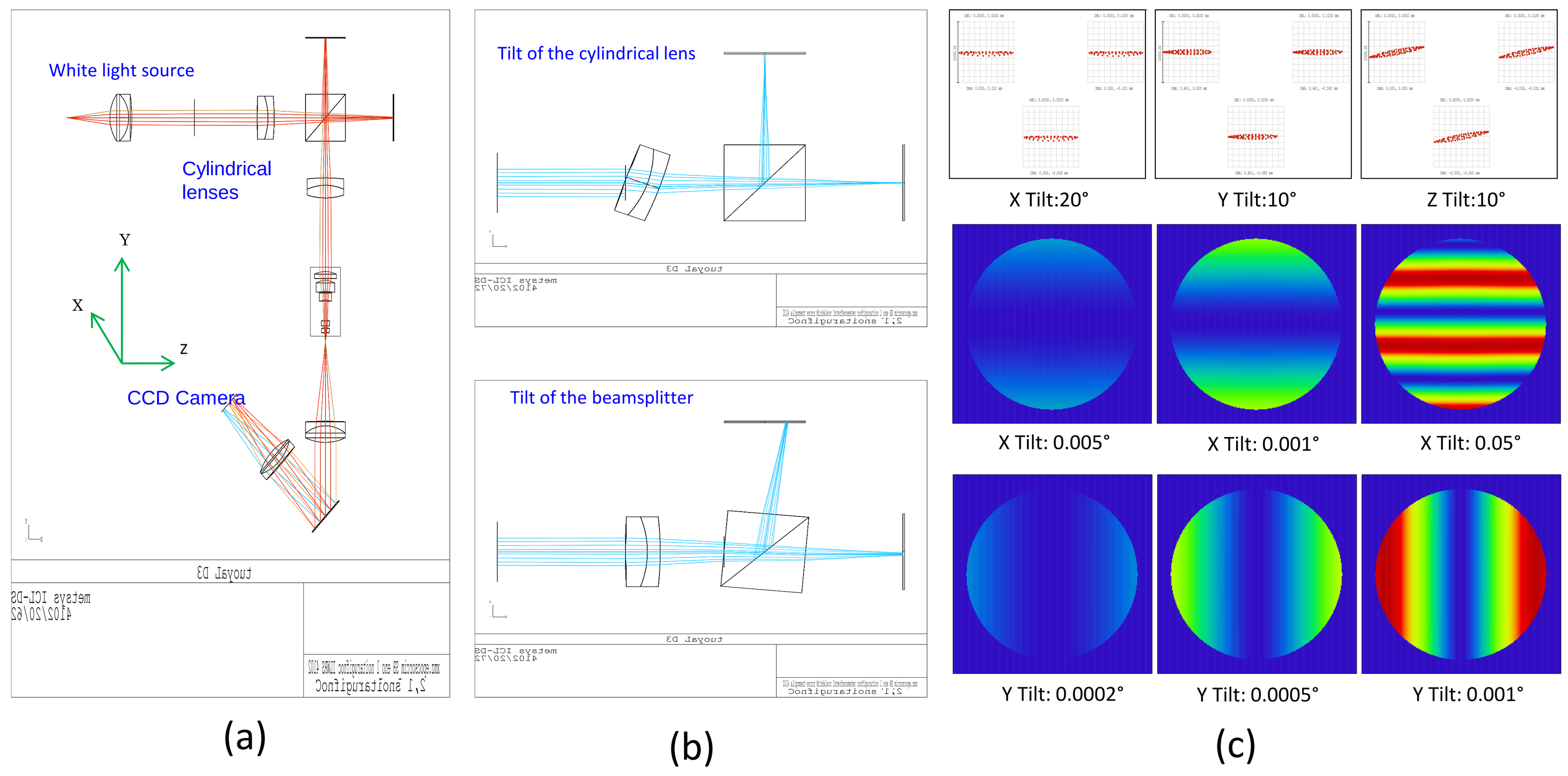

Fig. 4. Simulation results: (a) 3D layout, (b) misalignment—tilt, (c) spot diagram and interferograms resulting from alignment error

Measurement results

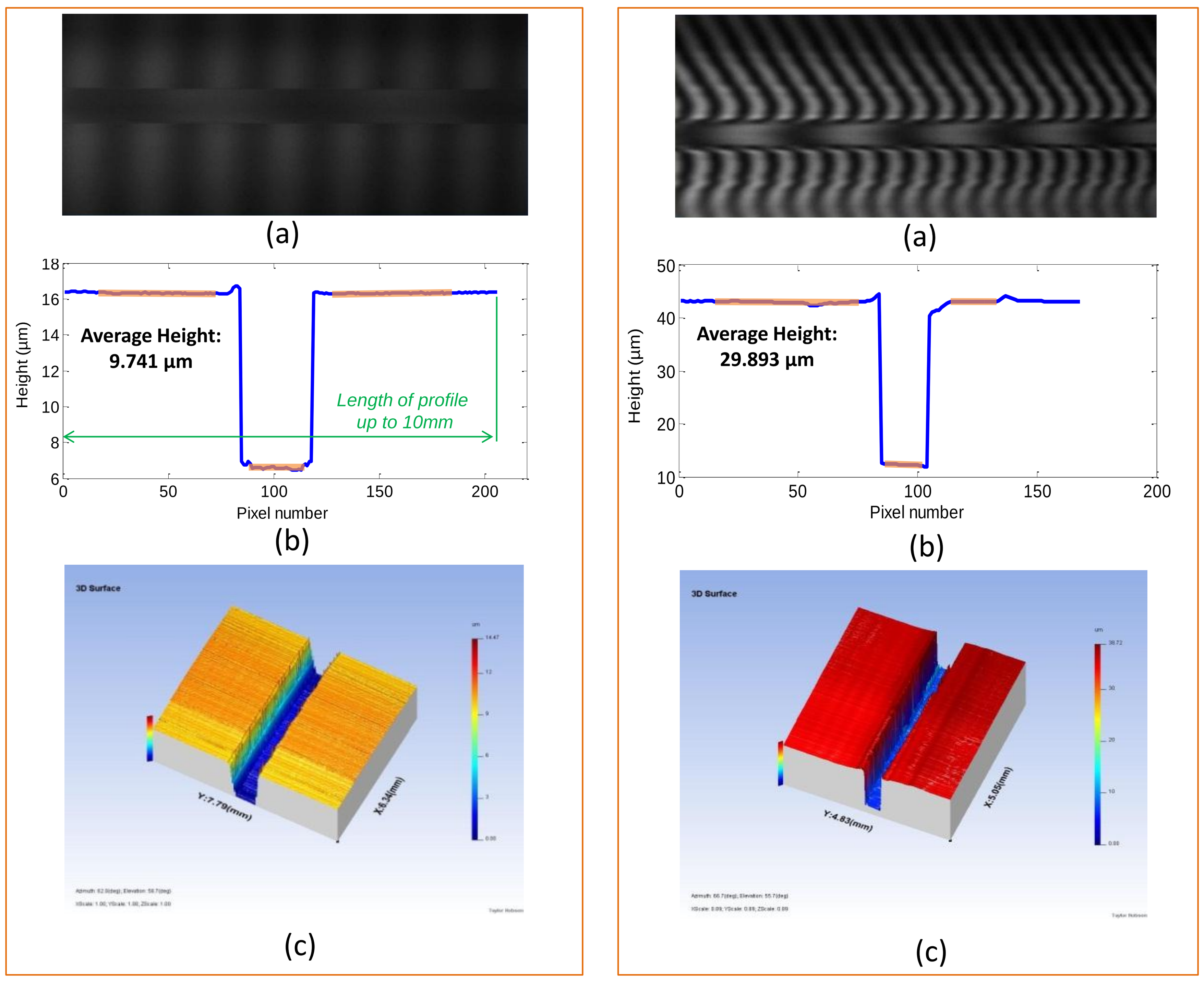

Fig. 5. Measurement results of 9.759 µm and 30 µm step heights :(a) captured interferogram, (b) 2D profile result, (c) 3D surface map

Conclusion

The performance of the proposed WLCSI was evaluated by measuring two step samples. Both 2D profile results and 3D surface maps closely align with the calibrated specifications given by the manufacturers, which verifies our setup is effective for applications like the R2R surface inspection, where only defects on the film surface are concerned in terms of the quality control.

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