



Design and vibration control of a notch-based compliant stage for display panel inspection applications



Wei-Chih Wang^a, Jer-Wei Lee^a, Kuo-Shen Chen^{a,*}, Yun-Hui Liu^b

^a Department of Mechanical Engineering, National Cheng-Kung University, Tainan 701, Taiwan, ROC

^b Department of Mechanical Engineering, Southern Taiwan University of Science and Technology, Tainan 710, Taiwan, ROC

ARTICLE INFO

Article history:

Received 24 September 2013

Received in revised form

25 December 2013

Accepted 17 January 2014

Handling Editor: L.G. Tham

Available online 7 February 2014

ABSTRACT

Both fast positioning and eliminating relative vibration between automatic optical inspection devices and the associated workpieces are critical for enhancing the throughput of product inspection. Both goals can be achieved by proper control of the stage where the camera is mounted. In this work, a one-dimensional compliant stage, consist of a notch-based structure and a mechanical amplifier, is designed and controlled for fulfilling the above mentioned goals. Essential finite element simulation and structural testing are performed to further characterize the structure and to obtain the system dynamics for controller design. The fundamental natural frequency of the designed stage is approximately 410 Hz and a displacement amplification ratio of 1.21 is achieved. The stage is actuated by a PI-843.40 piezoelectric actuator and the motion is monitored by an ASP-10-CTR capacitance probe. The entire signal acquisition and control are performed under a NI LabView environment using a NI cRIO-9014 FPGA real time controller, where both PID and sliding motion controllers are implemented. The results indicate that a close loop bandwidth of 12 Hz or 29 Hz and a steady state resolution of 50 nm can be achieved after PID or sliding mode control. With such a response, the motion induced vibration may be suppressed for subsequent automatic optical inspection and other applications such as coordinate measurement systems.

© 2014 Elsevier Ltd. All rights reserved.

1. Introduction

Recently, with the advancement of semiconductor applications and precision manufacturing, the requirements in fabrication, metrology, and inspection for the associated products impose stringent demands on high precision positioning controls. Among those applications, automatic optical inspection (AOI) requires accurate and efficient motion control for positioning. AOI relies on image processing for inspecting particular features on the surface of objects as the inputs for subsequent actions in quality assurance, assembly, or defect repair [1–4]. The performance of motion control directly affects the accuracy and perhaps the yield of the entire process. For most quality inspection applications, objects are placed on a platform and the corresponding inspection device is mounted on a moving gantry being actuated and controlled. The dynamic characteristics of the system are critical since it directly influences the complexity and effectiveness of the subsequent motion controller design.

* Corresponding author. Tel.: +886 6 2757575x62192.

E-mail address: kschen@mail.ncku.edu.tw (K.-S. Chen).

In this work, the major application to be considered is a typical liquid crystal display (LCD) array repair system schematically shown in Fig. 1a and a system we are currently investigating (shown in Fig. 1b). Principally, LCD products or rectiles are placed on a fully isolated optical table. Meanwhile, a CCD camera is attached to a stage, which is mounted on a gantry sliding on the optical table. In a manner similar to that of coordinate measurement machines (CMMs) [5], this gantry places the camera in the desired location. Once the camera reaches the destination, it can perform subsequent optical

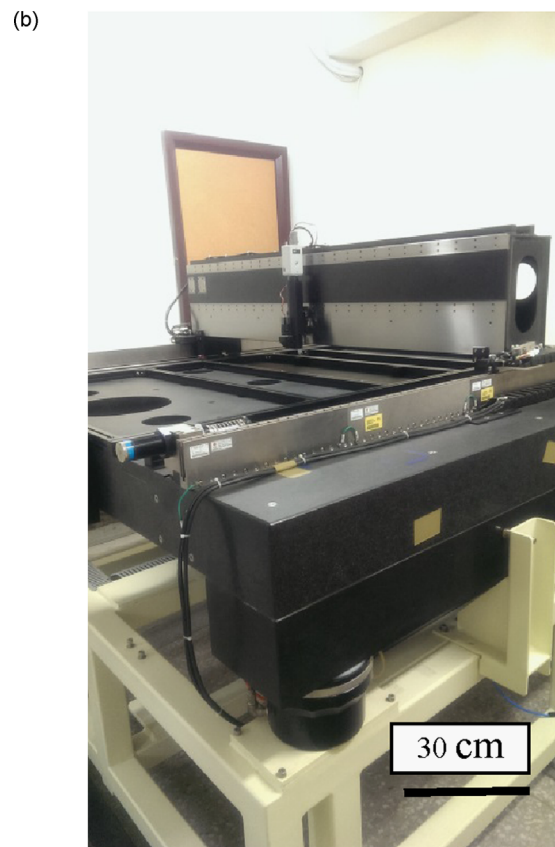
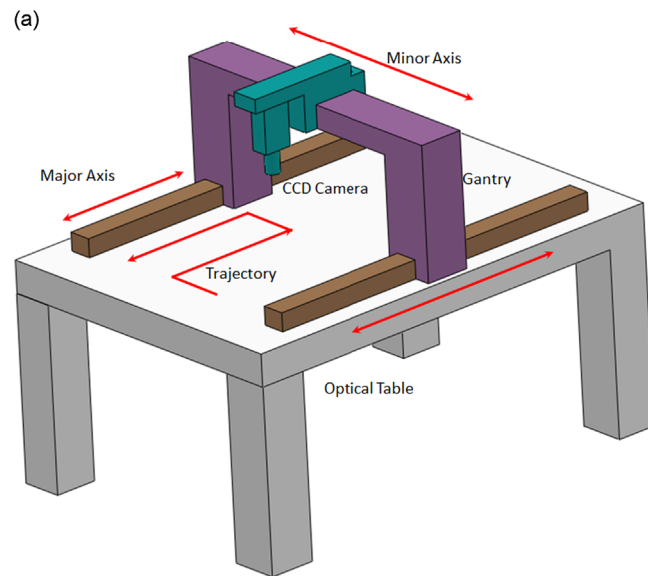


Fig. 1. Schematic plot of (a) an AOI system mounted on a gantry over an optical table, (b) our current system corresponding to (a) for investigation, and (c) the proposed design (with an X–Y stage between the AOI and the gantry).

Download English Version:

<https://daneshyari.com/en/article/287800>

Download Persian Version:

<https://daneshyari.com/article/287800>

[Daneshyari.com](https://daneshyari.com)