UNIVERSITI TEKNOLOGI MARA

DISTRIBUTED SINGLE MODE FIBER SENSOR AND FIBER BRAGG GRATING FOR DISPLACEMENT AND TEMPERATURE SENSING

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Science

October 2012

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

This dissertation discuss the research works on distributed optical fiber sensor system consisting of optical fiber-loop sensor incorporating fiber Bragg grating (FBG) for displacement and temperature detections. The fiber-loop sensor was designed using single mode fiber (SMF) to exhibit signal attenuation due to the macrobending perturbation in the optical fiber. A novel fiber-loop design was used to investigate the optical attenuation due to macrobending effect in the fiber-loop. The bending effect would cause higher optical signal loss when the fiber-loop diameter is further reduced due to the force action of displacement. The single mode fiber sensor (SMF-sensor) was characterized using optical time domain reflectometer (OTDR), optical spectrum analyzer (OSA), and optical power meter (OPM and OFM). Single SMF-sensor was characterized and the result was used in developing a distributed sensing system consists of three SMF-sensors along the monitoring line. The SMF-sensor is capable to detect faults simultaneously at several different locations. The fiber-loop sensing-head has a sensitivity of 0.044 dB/mm and 0.024 dB/mm measured using OTDR and OSA respectively. OTDR provides higher sensitivity in detecting displacement per millimeter unit besides precisely locate the fault point. The SMF-sensor was installed on lab-scale hill-slope simulator to test the response of the optical signal when the slope structure was displaced at different directions. SMF-sensor gives higher responsive when detecting displacement in horizontal-direction with a recorded sensitivity of 0.175 dB/mm and able to detect ground displacement initially at 5±0.1 mm displacement. FBG incorporated in the system served as temperature sensor. FBG recorded a sensitivity of 0.01 nm/°C when detected temperature changes.

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