Proceedings of the 7th International Conference on Mechanics and Materials in Design
Albufeira/Portugal 11-15 June 2017. Editors J.F. Silva Gomes and S.A. Meguid.
Publ. INEGI/FEUP (2017)

PAPER REF: 6576

MECHANICAL ANALYSIS OF A STRAIN WEARABLE SENSOR

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ABSTRACT

This work presents the tensile test of a developed strain wearable sensor. With the help of an extensometer (Shimadzu Autograph IG-IS 500N) the wearable strain sensor was stretched at a velocity of 1 mm/min. The mechanical test performed allowed to prove that the strain wearable sensor has a stable and reproducible response over time.

Keywords: wearable applications, fiber optic sensors, elongation sensor.

INTRODUCTION

An optical fiber sewed into a double wave shape on the top of an elastic textile enables the modulation of light amplitude with respect to strain on the textile (Lee 2003). This apparatus, in combination with small-size instrumentation, enables the development of a wearable textile garment capable of monitoring and acquiring strain data. The unique properties of optical fibers contribute to enhance the performance of strain sensors, making them capable of providing reliable solutions for those applications, where conventional sensors are not suitable (Grattan and Meggitt 2013). Glass optical fibers have some good properties, such as lightweight, small diameter and no threat of electrical risk (Li, Yang et al. 2012). The strain data can then be used to monitor sit posture during working day, providing useful information that enables back bone posture corrections, which will avoid back bone injuries (Dunne, Walsh et al. 2006).

The strain wearable sensor was tested in extensometer Shimadzu Autograph IG-IS 500N. A velocity of 1 mm/min was used to stretch the sensor up to 50 mm. Two cycles at 1 Hz sampling rate were taken. With this approach, it was possible to control the elastic textile stretching length, and consequently evaluate the elongation measurements results from the optical fiber sensor.

RESULTS AND CONCLUSIONS

Fig. 1 shows the elongation profile from the strain wearable sensor at 1 mm/min. The output voltage from the sensor increased when the displacement increased, and it remained stable when the extensometer halted at the maximum displacement (50 mm). Reverse behavior is shown when the extensometer decreased the displacement from 50 mm to resting position. At this point, the sensor's output voltage returns to its initial value. The little resting time at the maximum extension and resting point justify the curve shape. Similar behavior is presented in the second cycle.

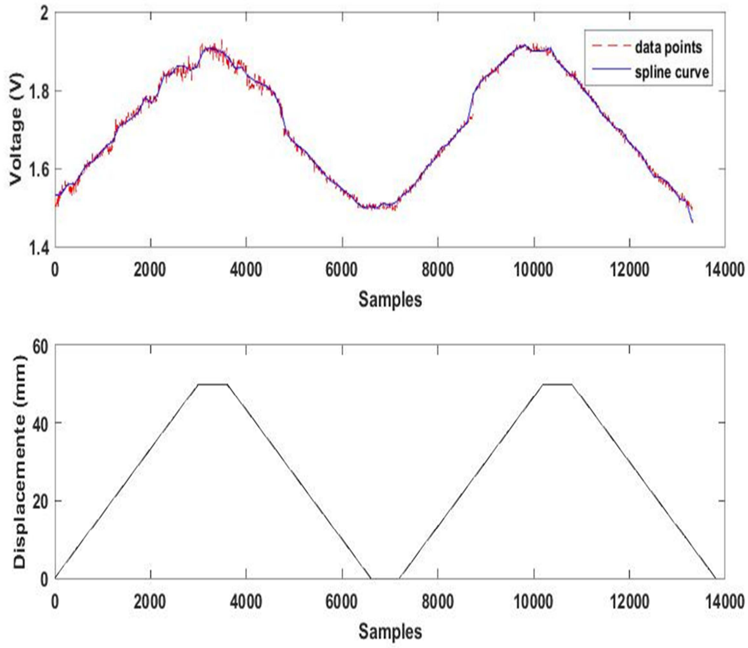

Fig. 1 - Strain wearable sensor elongation profile at 1 mm/min.

With the performed work, it is possible to prove that optical fibers can be embedded into wearable textiles as autonomous wearable devices in order to measure displacements induced by applied forces into the textiles. Further tests should be performed in order to analyze other mechanical properties, such as flexural properties. This preliminary results show a direct and consistent correlation between the sensor's displacement and the output voltage sensed in the optical sensor.

ACKNOWLEDGMENTS

This work is funded by FEDER funds through the COMPETE 2020 Programme and National Funds through FCT - Portuguese Foundation for Science and Technology under the project UID/CTM/50025/2013, the PhD grant SFRH/BD/52352/2013, and the MIT-Portugal Program. The authors would like to acknowledge the support from CeNTI - Centre for Nanotechnology and Smart Materials, Famalicão, Portugal.

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