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Using deep learning to design and optimize an optical fiber temperature sensor with an isopropanol cover

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Abstract
In this paper, an optical fiber temperature sensor is designed that uses isopropanol to increase temperature sensitivity and deep learning to characterize changes in the three-dimensional pattern of light propagation along the optical fiber and determine the ambient temperature. In other words, changing the ambient temperature changes the refractive index of isopropanol and causes a change in the appearance of the interference pattern of the guided modes inside the optical fiber, which identifies the pattern based on deep learning detects the changes in the appearance of light emission and estimates the ambient temperature optimally. In this regard, the mentioned optical fiber was simulated by Rsoft software for 106 different temperatures and their 3D propagation patterns were obtained. From the collection of simulated patterns, a complete database of propagated light for the temperature range of -73 to 82 degrees Celsius has been formed. The mentioned database is entered into the pattern recognition algorithm based on deep learning, and the pattern recognition system is taught how the appearance of light propagation changes in the fiber with temperature changes. The model used in this article is inspired by the AlexNet network and can obtain the ambient temperature with a minimum mean square error of 2.

Keywords: optical fiber temperature sensor, isopropanol, deep learning, pattern recognition, Rsoft

For full article, refer to the Persian section