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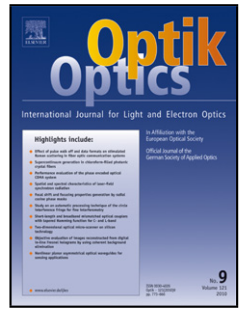

Title: Consistent neural network empirical physical formula constructions for nonlinear scattering intensities of dye-doped nematic liquid crystals with ultraviolet pump laser-driven Fredericksz threshold shifts

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Consistent neural network empirical physical formula constructions for nonlinear scattering intensities of dye-doped nematic liquid crystals with ultraviolet pump laser-driven Fredericksz threshold shifts

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Abstract

Intrinsic high nonlinearity in experimentally measured laser scattering intensities poses significant difficulties in analyzing various molecular and optical properties of nematic liquid crystals (NLCs). In this respect, as we theoretically proved in a previous paper, universal nonlinear function approximator layered feedforward neural network (LFNN) can be applied to construct consistent empirical physical formulas (EPFs) for nonlinear physical phenomena.

The novelty of this paper is that, by using our previous conference paper data (literature data or simply data for short) for He-Ne probe laser illumination nonlinear scattering intensities of dye-doped NLCs with ultraviolet pump laser-driven Fredericksz threshold (FT) shifts, we constructed *definitive* LFNN-EPFs for *these* illumination intensities of nonlinear scattering exhibiting FT shifts. The dyes used in the literature data were methyl red (MR) azo and disperse red (DR) anthraquinone. The LFNN-EPFs fitted the data very well. Moreover, magnificent LFNN test set forecastings over *previously unseen* data confirmed the consistent LFNN-EPFs inferences of the intensities of scattering. The LFNN-EPFs properly extracted the FT threshold shifts, as well as revealing the intensity dependencies on the kind of dye used. We, therefore, conclude the LFNN consistently infers *nonlinear* physical laws governing the NLC scattering data. Provided that sufficient scattering intensity data is available, these *nonlinear* physical laws embedded in LFNN-EPFs may potentially be useful for investigating various NLC molecular structure parameters in *molecular nonlinear optics* domain. This knowledge may be applicable in developing new optical materials.

Key words: neural network, empirical physical formula, nematic liquid crystal, Fredericksz transition, azo and anthraquinone dyes, scattering intensity, ultraviolent laser.