Compensation of Optical Signal Error through Digital Post-processing

Advantages
• More versatile and adaptable than existing error correction techniques
• Fully compensates for dispersive and nonlinear intra- and inter-channel impairments

Invention
The design for an error compensation method for optical information or imaging systems which suffer from linear and nonlinear impairments through an electronic post-processing, back propagation method.

Background
Optical signal processing hinges on the system’s ability to compensate for the error accumulated by optical pulses as they travel through air or a waveguide apparatus, such as a fiber optic cable. The optical signal unavoidably succumbs to a variety of impairments, including absorption, dispersion, nonlinearities, and amplifier noise. In the past, optical techniques have attempted to physically compensate for these errors, but have led to only marginal success as physical systems vary greatly in detail. Therefore, the trend has shifted toward electronic error correction, and UCF researchers have developed a digital signal processing (DSP) method of post-compensation for these impairments.

First applied to artificial neural networks, backward propagation of errors (back propagation) is a method for teaching a data correcting element the response of a non-linear system when it is not possible to use standard impulse response methods. This method is applied here to an algorithm that learns the amount of each optical error present in the system using a known teaching signal. A received and impaired signal is sent backward through a virtual version of the system to gauge error weights. The system then uses that knowledge to compensate for normal operational signal recognition.

Application
This error correction tool learns a system based on known sources of error and can therefore be implemented on the back end of any optical signal processing or imaging system. A wide variety of industries, from telecommunications to bio imaging, could utilize this invention to greatly increase the capabilities of their products and services.

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Selected References