decodable codes of the nonbinary case

The set of numbers \( \{ V_1, V_2, \ldots, V_n \} \) is then fed to the MAX network to result in a correct output. The constant-time majority network can be applied to decode those majority-decodable codes of the nonbinary case [9], for example.

Conclusion: We have presented efficient neural network solutions to sorting and related problems which are important primitives for neural networks themselves and other computing models. The main idea used in this approach is to convert the solution, expressed in logic form, into a set of discriminant functions of the perceptrons. This is a quite systematic method for constructing neural networks in solving problems because it has about the same level of complexity as writing an algorithm.

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PILOSECOND SQUARE PULSE GENERATION USING NONLINEAR FIBRE LOOP MIRROR

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Indexing terms: Pulse generation, Nonlinear optics

Square pulses with controllable picosecond durations have been generated from a CW input signal in the region of 1-5 ps by using switching in a nonlinear loop mirror. The square pulses are generated in synchronism with a pulsed driver which can be a noise burst. Shaped pulses have also been derived using this technique.

The nonlinear ring interferometer [1] in fibre form [2] has been extensively studied with particular emphasis on ultrashort, all-optical switching and has been successfully demonstrated for both silicon and nonsilicon optical fibers, in various geometries [3, 4]. For nonsilicon pulses, intensity dependent switching in most cases gives rise to fragmentation of the switched pulse. Square pulses do not exhibit this characteristic and consequently are preferable for some applications. Here we describe a simple technique to generate square pulses or shaped pulses, based on a wavelength operation of a nonlinear loop mirror [5, 6]. The pulses to be generated are derived from a CW input signal, driven by a pulse or noise burst derived from a laser source, such that the generated pulses are in time synchronism with the driver. In the work reported here the derived square pulses had durations of 35 ps.

A schematic diagram of the experimental arrangement is shown in Fig. 1. The pulse formation mechanism is based on the switching of a nonlinear Sagnac interferometer, which has been described previously [6-8]. Simply, in the absence of a switching pulse the transmission through the interferometer, for a low level signal (at a wavelength where the coupler has a 3 dB splitting ratio), is zero. In the presence of the switching pulse (at a wavelength where the coupler is imbalanced), through crossphase modulation, the signal experiences a net phase disturbance and is transmitted. The duration of the transmitted signal is dependent on the duration of the switching pulse and the relative group delay dispersion at the signal and switching wavelengths. Where the tracking is perfect the switched pulse will have a duration equal to that of the switching pulse. In the presence of complete walkoff, the switched pulse experiences a constant phase shift over its duration (apart from the rising and falling edges) generating a square pulse, the duration of which depends on the magnitude of the dispersions and loop length. Similarly, by mixing fibres with different dispersions within the loop, various shaped pulses can be generated.

The switching pulse was derived from the fibre-grating pair compressed output of a mode-locked Nd: YAG laser operating at 1-32 µm. This generated 3 ps pulses at 100 MHz, allowing an average power of up to 100 mW in the fibre. When the signal, tunable around 1-53 µm, was obtained from a CW erbium fibre laser or a semiconductor laser, with maximum average powers of 30 mW and 1 mW obtained in the fibre, respectively. Signal and switching pulse were combined via a 3 ps

Fig. 1 Schematic diagram of experimental setup

The switching pulse was derived from the fibre-grating pair compressed output of a mode-locked Nd: YAG laser operating at 1-32 µm. This generated 3 ps pulses at 100 MHz, allowing an average power of up to 100 mW in the fibre. When the signal, tunable around 1-53 µm, was obtained from a CW erbium fibre laser or a semiconductor laser, with maximum average powers of 30 mW and 1 mW obtained in the fibre, respectively. Signal and switching pulse were combined via a WDM and launched into the nonlinear optical loop mirror formed from a coupler with a 30:30 splitting ratio at 1-53 µm and 90:10 at 1-32 µm. Various lengths of fibre with different dispersion minima were used within the loop, depending on the required output pulse shape. The switched pulse was passed through an in-line Faraday isolator (FI) and then amplified in a 15 m length of standard Al2O3-GeO2-SiO2 based, erbium-doped single mode fibre, which was pumped in a counter-propagating geometry at 980 nm via the auxiliary WDM. The amplified, generated pulse shape exited the other port of the WDM with average powers in the milliwatt range and was detected using an optical sampling oscilloscope and scanning spectrograph.

For square pulse generation, the fibre used within the loop was 20 m long with a dispersion minimum at 1-32 µm. At the operating wavelengths and from the dispersive parameters of the fibre, a square pulse shape of 30 ps pulse duration was predicted (see Fig. 2a). This takes into account the finite response time of the optical sampling oscilloscope detector and the response function of the NOLM. Experimentally, a square pulse of approximately 34 ps was recorded as shown in Fig. 2a. This generated pulse was in time synchronism with the driving pulse. By modifying the fibre-grating arrangement, it is possible to generate noise bursts. By allowing total walkthrough of the noise burst, constant phase square pulses can still be generated. Because diode laser sources can be used to give rise to switching, [8], it should be possible to use noise bursts from diode lasers to generate square pulses.

Replacing the fibre in the loop by a 10 m piece with a dispersion minimum at 1-45 µm and tuning the CW diode laser source, allowed perfect tracking between switching pulse and signal disturbance. This permitted the generation of
correlations revealed the actual pulses to be detector limited pulse durations of 14ps (see Fig. 3). Autocorrelations of the pulses showed that the pulses were detector limited pulse durations of 14ps. Fibres with differing dispersion within the loop and experimental realisation of the square pulse were fused together with 2m of fibre with dispersion minimum at 1.45μm to constitute the loop. Fig. 3 shows the predicted pulse shape and Fig. 3c shows the experimental pulse as measured on the optical sampling oscilloscope. To obtain a pulse with two distinct intensity levels, the fibre that was used to generate the square pulse was fused together with 2m of fibre with dispersion minimum at 1.45μm to constitute the loop. Fig. 3 shows the predicted pulse shape and Fig. 3e shows the experimental pulse as measured on the optical sampling oscilloscope. In summary, we have demonstrated the generation of picosecond square pulses using two wavelength operation of a nonlinear optical loop mirror. These pulses are in time synchronism with the driving pulse and the driving pulses could potentially be derived from a pulsed noise burst from a semiconductor laser. It should also be noted that by removing the CW input and the isolator and correctly placing a partially transmitting mirror at the output, it is possible to optimise and construct a synchronously modulated subpicosecond erbium laser, although there is little advantage to this rather cumbersome approach to mode locking an erbium fibre laser.

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LONGITUDINAL COMPONENT OF APERTURE ELECTRIC FIELD IN WEAKLY-EXCITED BROADWALL SLOT

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Indexing terms: Waveguides, Antenna radiation patterns

For longitudinal slots cut in rectangular waveguides, the longitudinal component of the aperture electric field is found to be significant when the offset is small even for narrow slots. Ignoring the E-longitudinal component can introduce substantial error in the computed scattering parameters for weakly excited slots.

Introduction: Resonant coupling and radiating slots cut in the broad wall of a rectangular waveguide have been investigated extensively in the literature. The method of moments solution to the pertinent integral equations for the slot aperture electric field generally yields accurate solutions. However, for weakly excited coupling and radiating slots, theoretically computed scattering data have been found to deviate from experimentally measured data. The deviation is attributed to approximations in the theoretical model such as the assumption of an even transverse distribution, satisfying the boundary condition for the H-longitudinal component (H-longitudinal) only, and ignoring the E-longitudinal component (E-longitudinal). Recently McNamara et al. have shown that the transverse distribution of the dominant E-field component can have a substantial odd symmetry in the transverse direction for small-offset longitudinal slots [1]. Their computed values for the E-longitudinal were not significant.