Now the two frequency offset values are suitably modified as

\[ \Delta f_1 = -f_r \frac{0.4185 ds}{s} \quad \text{for } \varepsilon_r < 4.5 \]
\[ \Delta f_2 = f_r \frac{0.4185 ds}{s} \quad \text{for } \varepsilon_r = 4.5 \]

The resonant frequencies corresponding to ports 1 and 2, respectively, are given by

\[ f_1 = f_r + \Delta f_1 \]  
\[ f_2 = f_r + \Delta f_2 \]

Conclusion: A novel dual port broad-band microstrip antenna resonating at two frequencies and providing orthogonal polarisations with very good isolation between the two ports is reported. The gain of the antenna is comparable to that of a standard circular patch microstrip antenna. This antenna may find application in systems where dual frequency operation with large bandwidth is required.

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matched to a different wavelength from the multiwavelength source and therefore $G$, reflects $\lambda$. The spacings between the gratings are arranged so that the relative time delay between adjacent optical wavelengths exhibited at each stage increases exponentially, i.e., $\tau_1, 2\tau_1, 2^2\tau_1, \ldots, 2^n\tau_1$. Here, $\tau_1$ is the relative time delay in the first stage of the PDM:

$$\tau_n = \frac{2 \cdot \Delta L_1 \cdot n}{c} \quad (1)$$

where $\Delta L_1$ is the grating spacing in the first stage, $n$ is the refractive index of the fibre, and $c$ is the velocity of light in free space.

An optical circulator is used to route the lightwaves. By programming the $2 \times 2$ optical switches, the total relative time delay generated by the PDM, $\tau_{PD}$, can vary from 0 to $(2^n-1)\tau_1$ in increments of $\tau_1$. At the receiver, a wavelength-division-multiplexed (WDM) demultiplexer routes $\lambda_i$ to the $i$th element of the array, giving rise to linear time shifts of $(0, \tau_{PD}, 2\tau_{PD}, \ldots, (n-1)\tau_{PD})$ across the array elements. The steering angle $\theta$ is

$$\theta = \sin^{-1} \left( \frac{c \cdot \tau_{PD}}{\lambda} \right) \quad (2)$$

for all RF frequencies, where $A$ is the distance between array elements.

Experiment: To demonstrate the concept of PDM, an experimental prototype with 2-bit resolution was constructed. An 80GHz monolithic passive CPM InGaAs-InGaAsP quantum well laser was used as the multiwavelength source [7]. The reduced mode partition noise in the mode-locked laser makes it a suitable multiwavelength source for this application [8]. Four gratings were implemented at each stage of the PDM to reflect optical wavelengths at 1546.85, 1547.47, 1548.09 and 1548.71nm from the CPM laser. The grating spacings in the first and second stages of the PDM were 1 and 2cm, respectively. All the gratings used in the setup had a reflectivity of 85% and an FWHM reflection band of 0.15nm. The RF signal was applied to all wavelengths through an external EO modulator with 5GHz bandwidth. A tunable fibre Fabry-Perot filter with 10GHz bandwidth was placed after the PDM to select different wavelength channels for time delay measurement. The selected channel was fed to a high speed photodetector. The time delay was measured using an HP 8510 microwave network analyser.

Summary: In conclusion, we have demonstrated a programmable dispersion matrix using a grating fibre for applications such as OCPAs. Compared to a PDM comprising dispersive fibre, the use of a fibre grating in a PDM as a tailorable dispersive element significantly reduces the system size and eliminates dispersion-induced signal distortion.

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References

Low dissipation power and high linearity PCS power amplifier with adaptive gate bias control circuit
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Indexing terms: Linearization techniques, Radiofrequency amplifiers

A new PCS power amplifier with gate bias control circuit has been developed for high efficiency at low output power level, and for high linearity at high output power level. The efficiency at an average operating power of 16dBm was improved to 10.5%, and the IMD3 at the maximum operating power of 27dBm to –33dBc.

Introduction: Power amplifiers with high power-added efficiency (PAE) and low intermodulation distortion have been required in CDMA personal communications service (PCS) systems to reduce power consumption and bit error rate. There were many reports on improving efficiency and linearising output power by methods such as feedforward [1] and predistortion [2]. However, because most of the efforts were focused on improving maximum efficiency near saturation output power, the efficiencies at the average operating power were poor. Moreover, most of the linearising techniques are difficult to apply to small size amplifiers for hand held phones due to their complexity. Meanwhile, there were some reports on improving efficiency [3] and intermodulation distortion [4] by adjusting gate bias controlled by input signal level. But, to our knowledge, there were no reports on achieving high efficiency and low third-order intermodulation distortion (IMD3) simultaneously.