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requirements for the award of the degree of
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To the Beneficent, the Merciful for Your protect, blessing, strength and unlimited love

To my beloved parents, my beloved husband, my beloved children and my beloved siblings for their continous loves and support

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ABSTRACT

Radio over fiber (RoF) technology provides an efficient and cost effective solution to increase the capacity of mobile communication systems and the coverage of wireless broadband communication systems. This is due to the growing data traffic and bandwidth demands. However, the performance of an RoF system is limited by the linearity of the optical transmitter that contributes to major nonlinear distortions in the links. Meanwhile, in multichannel applications, high linearity is required to avoid a channel interference due to nonlinear distortions. The feedforward linearisation technique offers a number of advantages compared to other techniques such as a broadband distortion reduction at high frequencies and simultaneous reduction in all orders of distortion. Therefore, it is suitable for linearisation of the optical transmitter. But, the existing design uses many electronic components causing difficulty for the amplitude and phase matching to achieve the optimum distortion reduction and also generate the parasitic parameter at high frequency. This thesis aims to improve the performance of the optical feedforward transmitter by reducing the electrical component without decreasing the distortion reduction performance; thus reducing the difficulty for the amplitude and phase matching and the parasitic parameter at high frequency. System characterisation is carried out by the mathematical analysis using Volterra series approach and simulation using a commercial optical design software which is validated by the practical measurement. It shows that the IMD3 reduction is good for high frequency. More than 15 dB IMD3 reduction is achieved over the carrier frequency 1.2 to 2.4 GHz using the proposed system practically. In addition, the proposed system is simpler and less sensitive in the amplitude and phase matching to obtain the optimum distortion reduction since the distortion suppression is influenced by less electrical parameters compared to other works.

ABSTRAK

Teknologi isyarat radio melalui gentian (RoF) merupakan satu penyelesaian yang cekap dan kos efektif untuk meningkatkan kapasiti system perhubungan bergerak dan liputan sistem perhubungan jalur lebar wayarles. Ini disebabkan oleh lalu lintas data dan permintaan lebar jalur yang sentiasa bertambah. Walau bagaimanapun, prestasi sistem RoF telah dihadkan oleh kelinearan pemancar optik yang menyumbang kepada herotan tak linear yang besar dalam pautan-pautannya. Sementara itu, dalam aplikasi berbilang saluran, kelinearan yang tinggi diperlukan untuk mengelakkan gangguan saluran yang disebabkan oleh herotan tak linear. Teknik pelinearan suap depan mempunyai beberapa kebaikan berbanding dengan teknik-teknik lain, seperti pengurangan herotan jalur lebar pada frekuensi tinggi dan pengurangan serentak herotan dari semua tertib. Oleh sebab itu, teknik tersebut sesuai untuk linearisasi pemancar optik. Tetapi, reka bentuk yang ada menggunakan banyak komponen elektrik yang menyebabkan kesulitan daripada padanan amplitud dan fasa untuk mencapai pengurangan herotan yang optimum dan juga membangkitkan parameter parasit pada frekuensi tinggi. Tesis ini bertujuan untuk memperbaiki prestasi pemancar suap depan optik dengan mengurangkan komponen elektrik tanpa menurunkan prestasi pengurangan herotan; sehingga kesulitan daripada padanan amplitud dan fasa dan parameter parasit pada frekuensi tinggi dapat dikurangkan. Pencirian sistem dijalankan dengan analisis matematik menggunakan penghampiran siri Volterra dan simulasi menggunakan perisian reka bentuk optik komersial. Reka bentuk tersebut disahkan oleh pengukuran praktik. Didapati bahawa pengurangan IMD3 adalah baik pada frekuensi tinggi. Lebih daripada 15 dB pengurangan IMD3 telah dicapai pada frekuensi pembawa 1.2 hingga 2.4 GHz menggunakan sistem yang dicadangkan secara praktik. Tambahan pula, sistem yang dicadangkan adalah lebih ringkas dan kurang sensitif dalam padanan amplitud dan fasa untuk mendapatkan pengurangan herotan yang optimum, disebabkan penindasan herotan dipengaruhi oleh pengurangan parameter elektrik berbanding kajian-kajian lain.