Performance Evaluation of Digital Modulation Schemes in Wireless Communication in Term Of Bit Error Rate (BER)

Submitted by

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ABSTRACT

With the advent of the internet and the smartphone it is evident that transmission and reception of digital data is a common daily occurrence and therefore this process must be as polished as possible. To achieve this, initially communication was switched to digital from analog due to the many concrete advantages such as security, compression and error correction. There are several digital modulation techniques and each of them is affected by noise to a different extent. Various factors should be considered for choosing a particular modulation scheme to be used in a communications system. Bandwidth efficiency and energy efficiency are the two parameters used to quantify the performance of modulation techniques. This thesis aim to analyses the performance of different modulations scheme which should be spectral efficient and possess low bit error-rate especially at lower signal-to-noise ratios. In This thesis various modulation schemes have been analyses in terms of their bit error-rate performance. Results showed that the lower order modulation schemes perform better than the higher order schemes. This comes at the detriment of the data rate, as lower order schemes have lower data rates compared with their higher order counterparts.

المستخلص

مع ظهور الإنترنت والهاتف الذكي ، من الواضح أن إرسال واستقبال البيانات الرقمية أمر شائع يوميًا وبالتالي يجب أن تكون هذه العملية مصقولة قدر الإمكان. لتحقيق ذلك ، تم تحويل الاتصال في البداية إلى الاتصال الرقمي من التناظري نظرًا للعديد من المزايا الملموسة مثل الأمان والضغط وتصحيح الأخطاء. هناك العديد من تقنيات التعديل الرقمي ويتأثر كل منها بالضوضاء بدرجات مختلفة. يجب مراعاة عوامل مختلفة لاختيار مخطط تعديل معين لاستخدامه في نظام الاتصالات. كفاءة عرض النطاق الترددي وكفاءة الطاقة هما المعلمتان المستخدمتان لتحديد أداء تقنيات التعديل. تهدف هذه الأطروحة إلى تحليل أداء مخطط التشكيلات المختلفة التي يجب أن تكون فعالة في استخدام الطيف وتمتلك معدل خطأ بتات منخفض خاصة عند معدلات الإشارة إلى الضوضاء المنخفضة. في هذه الأطروحة ، تم تحليل مخططات التعديل المختلفة من حيث أداء معدل الخطأ في البتات. أظهرت النتائج أن مخططات التعديل ذات الرتبة الأدنى تؤدي أداءً أفضل من أنظمة الترتيب الأعلى. يأتي هذا على حساب معدل البيانات ، حيث أن مخططات الترتيب الأدنى لديها معدلات بيانات أقل مقارنة بنظيراتها ذات الترتيب الأعلى.

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5.1 Conclusions

Various modulation schemes have been analyses in terms of their BER performance and the analysis has yielded the following conclusions:

- Under the applications that do not require high data rate, it is best to use BPSK or QPSK as they offer the least amount of BER.
- Higher order QAM can transmit more data but are less reliable due to its high error rate when compared to lower order QAM.
- BPSK gives least error rate and with the increase in order of modulation, Bit error rate goes on increasing with SNR.
- Lower order modulation schemes perform better than the higher order schemes but this comes at the expense of the data rate.
- The simulation results of Bit Error Rate (BER) displays that the implementation of BPSK, QPSK modulation technique gives less error at worst channel conditions as compared to QAM modulation techniques.

5.2 Recommendations

This research study can be extended in numerous ways. The improved digital modulation scheme performance analysis can be extended as listed below:

- Higher order QAM can transmit more data but are less reliable due to its high error rate when compared to lower order QAM. However it is possible to reduce the error by introducing error-correction techniques, such as convolution coding and turbo coding, which helps to improve the system performance.
- To maintain a good data rate, it is advisable to employ an adaptive modulation scheme which switches between the simple, low data rate and complex, high data rate modulation techniques depending on the SNR of the received signal.