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碩 士 論 文

基於無線多媒體通訊之資源分配技術

Resource Allocation Techniques for Wireless Multimedia Communications

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摘要

數位通訊系統的設計，長久以來專注於增加傳輸速率以達成終端用戶的高速下行傳輸需求。這造成通訊系統的下行傳輸速率普遍高於上行傳輸速率的情形。隨著網路電話、視訊會議、多媒體通訊服務、照相手機、互動遊戲等高傳輸速率應用的普及，傳輸速率的不對稱性逐漸的受到關注。因此通訊設計逐漸以提高上行傳輸的頻譜效率及服務質量(QoS) 為發展主軸，以提供穩定的資料傳送服務。為達成上行高速傳輸，正交分頻多工 (OFDM)、多輸出多輸入技術(MIMO)等傳輸技術已被廣泛的應用在無線傳輸。然而，系統資源如果無法有效的分配，這些傳輸技術將無法達到充分的開發利用。

在本論文內，我們發展出跨層動態排序子載波選取演算法(CLDOSSA) 應用於正交分頻多工之影像上傳系統。藉由影像的內容資訊分析並搭配最適合子載波選取，以達成影像的不平等錯誤保護(UEP)。相對於先前所提出之排序子載波選取演

算法(OSSA)，我們提出的方法可以提供更高的傳輸穩定性，使得影像傳輸的品質獲得提升。模擬結果指出，我們所提出的方法可以達到更高的 PSNR 相對於平等錯誤保護(EEP) OSSA 及 UEP OSSA。此外，在低 SNR 傳輸時，PSNR 可獲得更顯著的提升。

其次，針對線性接收器之多輸出多輸入正交分頻多工(MIMO-OFDM)的空間多工系統，我們採用和 CLDOSSA 相似的想法，提出最佳化多重模式前置編碼演算法以增加空間多工的多樣選取性，因此不需借助於高運算複雜度的接收器，例如: 最大可能性法則接收器(ML)、VBLAST，來提升多樣選取性。模擬結果指出，相較於現有的演算法，多重模式前置編碼演算法可提供更高的傳輸穩定性，藉由子載波的傳輸資料匯流選取及微弱子載波輔償。除此之外，因為前置編碼的操控是由接收端來決定，所以主要的運算複雜度將是由接收端來負擔，我們所提出的方法是個適合上行傳輸的通訊技術。

關鍵詞：資源分配, 正交分頻多工, 排序子載波選取演算法, 跨層動態排序子載波選取演算法, 不平等錯誤保護, 跨層設計, 多輸出多輸入技術, 多重模式前置編碼

Resource Allocation Techniques for Wireless Multimedia Communications

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Abstract

The design of digital communication systems have traditionally been focused on increasing transmission rate of the downlink because of higher downlink throughput requirement of the end users. This has created a communication model in which the data rate on the downlink is higher than that of the uplink. However, voice over IP (VoIP), video conferencing, multimedia messaging service, camera phones, gaming, and other high-data-rate applications have made the assumption of asymmetric data rates questionable. This has motivated many to devise new techniques to increase spectrum efficiency and quality-of-service (QoS) in the uplink. For wireless communications, orthogonal frequency multiplexing (OFDM) and multiple-input multiple-output (MIMO) are two popular techniques that have been widely touted to deliver on such promise. However, full potential of these transmission methods cannot be realized unless system resources are properly allocated.

In this thesis, a novel resource allocation technique called cross-layer dynamic ordered subcarrier selection algorithm (CLDOSSA) for OFDM based video uplink transmission is proposed. The proposed scheme is shown to achieve higher link

reliability, and hence higher transmitted video quality, than the previously proposed OSSA based methods by exploiting content information such that the most suitable subcarriers are optimally chosen for transmission with unequal error protection (UEP) being offered to content of different importance. Simulation results have shown OFDM based systems that utilize the proposed scheme can achieve higher PSNR, especially at low SNR, compared to those that use the equal error protection (EEP) OSSA and UEP OSSA.

Next, a novel bit error rate optimized multimode (number of antennas and subcarriers are dynamically selected) selection/precoding algorithm for MIMO-OFDM based spatial multiplexing systems using linear receivers is proposed. The proposed precoder design exploits similar ideas that were inherent in the design of the CLDOSSA. The proposed method increases the diversity advantage of spatial multiplexing systems without the use of computational expensive space-time receivers such as ML and VBLAST. Simulation results have shown that the proposed multimode technique outperforms existing ones in terms of link reliability by performing selection of data streams across different subcarriers, and compensating significantly attenuated subcarriers due to deep fades. Since the precoding parameters are determined at the receiver, this makes the present scheme ideal for uplink communications as most of the computational complexity resides at the receiver.

Keywords: Resource allocation, OFDM, OSSA, CLDOSSA, UEP, Cross-layer design, MIMO, Multimode precoder

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