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Resource allocation method for improved energy efficiency in mimo -ofdm wireless systems

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ABSTRACT

In the past several researches , various Antenna Selection Strategies for MIMO-OFDM wireless Systems is investigated based on Energy Efficiency perspective . In Adaptive Method there is a Significant loss in the Energy Efficiency and Energy Efficiency(EE)-Spectral Efficiency(SE) Trade-Off.

To achieve a better Energy Efficiency, Based on the practical model we investigate Resource Allocation Task .It is formulated as an optimization problem that aims at maximizing the weighted sum-rate of MIMO Broadcast channels . We are witnessing a paradigm shift from Throughput optimization to Energy Efficiency optimization methods and the Fractional Programming Theory concerned with Optimization and Properties of Fractional Functions to improve Energy Efficiency over Traditional Resource Allocation Schemes.Resource Allocation include effectively setting up equipment and operations and about increasing profits and Productivity While minimizing Resource Wastage.

INTRODUCTION

Multiple-input multiple-output (MIMO) wireless technology in combination with orthogonal frequency division multiplexing (MIMO-OFDM) is an attractive air-interface solution for next-generation wireless local area networks (WLANs), wireless metropolitan area networks (WMANs), and fourth-generation mobile cellular wireless systems. The key challenge faced by future wireless communication systems is to provide high-data-ratewireless access at high quality of service (QoS).Combined with the facts that spectrum is ascarce resource and propagation conditions arehostile due to fading (caused by destructive addition of multipath components) and interference from other users, this requirement calls for

means to radically increase spectral efficiencyand to improve link reliability. Multiple-inputmultiple-output (MIMO) wireless technology seems to meet these demands by offeringincreased spectral efficiency through spatial-multiplexing gain, and improved link reliabilitydue to antenna diversity gain. Even though

there is still a large number of open researchproblems in the area of MIMO wireless, bothfrom a theoretical perspective and a hardwareimplementation perspective, the technology hasreached a stage where it can be considered

ready for use in practical systems. In fact, thefirst products based on MIMO technology havebecome available, for example, the pre-IEEE802.11n wireless local area network (WLAN)systems by Airgo Networks, Inc., Atheros Communications, Inc., Broadcom Corporation, Marvell Semiconductor, Inc., and MetalinkTechnologies, Inc. Current industry trends suggest that large-scale deployment of MIMO wireless systems will initially be seen in WLANs and in wireless metropolitan area networks (WMANs). Corresponding standards currently under definition include the IEEE

802.11nWLAN and IEEE 802.16 WMAN standards.Both standards define air interfaces that arebased on the combination of MIMO withorthogonal frequency division multiplexing(OFDM) modulation (MIMO-OFDM). Ongoing fourth-generation mobile cellular systemprestandardization efforts in Europe, which arecarried out in the context of various “IntegratedProjects,” funded by the European Commissionwithin its Sixth Framework Program (FP6), alsoshow strong support for a MIMO-OFDM airinterface.The goal of this article is to provide a high-level review of the basics of MIMO-OFDMwireless systems with a focus on transceiverdesign, multiuser systems, and hardware implementation aspects. The remainder of this article is organized as follows. The next sectioncontains a brief introduction into MIMO wireless and OFDM. We then discuss space-frequency signaling and corresponding receiverdesign for MIMO-OFDM systems. An overviewof multi-user MIMO-OFDM systems is followed by a summary of recent results on theVLSI implementation of a four-stream spatial-multiplexing MIMO-OFDM transceiver.

Traditionally, multiple antennas (at one side ofthe wireless link) have been used to performinterference cancellation and to realize diversityand array gain through coherent combining. Theuse of multiple antennas at both sides of the link

Array gaincan be realized both at the transmitter and the receiver. It requires channelknowledge for coherent combining and results inan increase in average receive signal-to-noiseratio (SNR) and hence improved coverage.Multiple antennas at one or both sides of the wireless link can be used to cancel or reduce co-channel interference, and hence improve cellular system capacity.

MIMO technology will predominantly be used inbroadband systems that exhibit frequency-selective fading and, therefore, intersymbol interference (ISI). OFDM modulation turns thefrequency-selective channel into a set of parallelflat fading channels and is, hence, an attractiveway of coping with ISI. The basicprinciple that underlies OFDM is the insertionof a guard interval, called cyclic prefix (CP),which is a copy of the last part of the OFDMsymbol (Fig. 1c), and has to be long enough toaccommodate the delay spread of the channel.The use of the CP turns the action of the channel on the transmitted signal from a linear convolution into a cyclic convolution, so that theresulting overall transfer function can be diagonalized through the use of an IFFT at the transmitter and an FFT at the receiver Consequently, the overall frequency-selectivechannel is converted into a set of parallel flatfading channels, which drastically simplifies theequalization task. However, as the CP carriesredundant information, it incurs a loss in spectral efficiency, which is usually kept at a maximum of 25 percent.In general, OFDM has tighter synchronization requirements than single-carrier (SC) modulation and direct-sequence spread spectrum (DSSS), is more susceptible to phase noise, andsuffers from a larger peak-to-average powerratio. While general statements on overall implementation point-of-view comparisons of OFDM,SC, and DSSS are difficult to make, recentindustry trends show a clear preference forOFDM-based solutions.

In general, there are two fundamental approaches for thedeployment of antenna selection in OFDM systems, namely,bulk selection (i.e., choosing the same antennas for allsubcarriers)and per-subcarrier selection (i.e., selecting antennas independently for each subcarrier). The main benefit of the latter over the former is that alarger capacity and/or better error performance can beachieved by exploiting the frequency-selective nature of thefading channels. However, the per-subcarrier selection scheme needs a larger number of radio frequency (RF) chains than bulk selection. Beside these two selection methods, acombined selection scheme has been considered recently in. This selection scheme combines the bulk selectionand per-subcarrier approaches. However, to the best of ourknowledge, all these works only investigated antenna selectionOFDM systems from both capacity or error-performance perspective, for example, analysing diversity gain and coding gain, measuring capacity, or evaluating error performance.Antenna selection is traditionally considered for improved capacity and/or error performance. Recently, some researchworks have investigated energy efficiency in antenna selectionsingle-carrier systems. In, the authors jointlyoptimized the transmit power and the number of activeantennas to maximize energy efficiency. This work examinedsingle data stream MIMO systems, while energy efficiency in multi-stream antenna selection MIMO single-carrier systems was studied in.Transmit antenna selection with a largenumber of equipped antennas at the transmitter was considered. In this study, the authors analyzed theenergy efficiency in a large-scale array regime and proposedantenna selection algorithms to improve energy efficiency. Alarge-scale distributed antenna system (L-DAS) thatconsidered antenna selection for improved energy-efficiencywas also proposed in. However, we note that these worksonly consider single-carrier systems, and an extension toantenna selection OFDM systems is not straightforward. Themain reason is that there are several approaches for OFDM systems as mentioned before. From an energy efficiencyperspective, it can be seen that each antenna selectionapproach possesses both advantages and disadvantages.

Specifically, per-subcarrier selection achieves better capacitythan bulk selection and combined selection at a cost of higherpower consumption due to the requirement of multiple activeRF chains. These critical issues, which are pertinent in thesetting of OFDM systems, do not arise in single-carrierantenna selection systems. Hence, they have not beenconsidered so far. In addition, some recent works on energy efficient MIMO-OFDM systems, e.g. Focused onlyon spatial multiplexing MIMO schemes, which did not addressthe above concerns. Therefore, a study is required to evaluateenergy efficiency of antenna selection MIMO-OFDM systems.Note that in [24], we investigated energy efficiency in per subcarrier antenna subset selection OFDM systems with theobjective of peak-power reduction. However, [24] onlyexamined the per-subcarrier selection system from a viewpointof power-amplifier efficiency, which is not the focus of the present work.To the best of our knowledge, there is no comprehensivestudy about the efficacy of antenna selection schemes in thecontext of OFDM systems from an energy efficiencyviewpoint in the literature. Consequently, it is not clear if theexisting antenna selection approaches (e.g., bulk selection,per-subcarrier selection, and combined selection schemes) areoptimal in terms of energy efficiency. Motivated by this, inthis paper, we investigate energy efficiency in MIMO-OFDMsystems with several antenna selection schemes. The maincontributions of this work are summarized as follows.*i)* Energy efficiency in conventional antenna selectionMIMO-OFDM systems is analysed for the first time. Inparticular, we derive closed-form expressions for theenergy efficiency and the EE-SE trade-off in thesesystems. Our results show that the conventional antenna selection systems are not effective with respectto energy efficiency.

ii) An adaptive antenna selection approach is proposed toimprove energy efficiency in MIMO-OFDM systems.In this method, both the number of active RF chainsand the antenna indices are selected to maximizeenergy efficiency. We also show that the proposedadaptive selection scheme achieves better EE-SE tradeoff compared to the existing selection schemes.*iii)* A greedy algorithm to implement the proposedadaptive selection method is developed. This algorithm can attain near-optimal energy efficiency whilerequiring much lower complexity compared to thatwith the optimal exhaustive search method, which isimportant when a number of antennas is large.*iv)* Efficiency of power loading across subcarriers in severalantenna selection MIMO-OFDM systems is evaluatedfrom an energy efficiency perspective.

PREVIES METHODS

ADAPTIVE ANTENNA SELECTION :

A. The system compares the antenna selection strategies for frequency selective MIMO-OFDM channels. Real channels are measured, and used to evaluate the performance. The system shows that the capacity gain predicted from the simulated Channels, is significantly lower than can be achieved over real channels. This supports the use of antenna selection in practical MIMO-OFDM systems. The system which uses the four selection methods, that are 1) Capacity optimum search 2) Minimum ratio of maximum and minimum channeleigenvalues 3) Maximum minimum channel eigenvalue. 4) Maximum SNR method. The system results reveals that, the achievable capacity gainusing MIMO-OFDM antenna selection decreases with theincrease of channelfrequencyselectivityandchannelbandwidth.

Disadvantages:

The antenna selection algorithms are too complex.

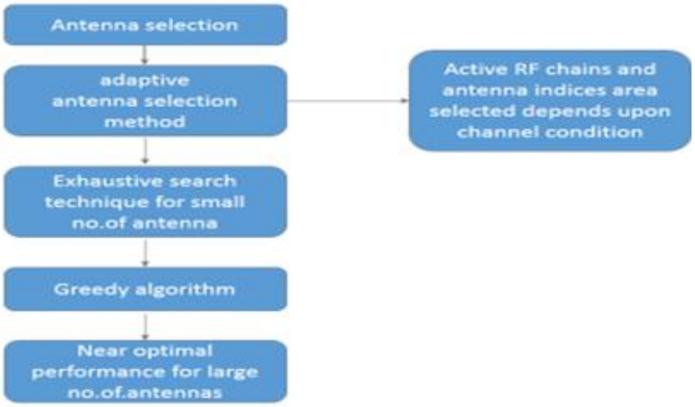
B. we first derive closed-form expressions ofthe energy efficiency and the energy efficiency- spectral efficiency(EE-SE) trade-off in conventional antenna selection MIMOOFDM systems. The obtained results show that these systemssuffer from a significant loss in energy efficiency. To achieve abetter energy-efficiency performance, we propose an adaptiveantenna selection method where both the number of active RF(radio frequency) chains and the antenna indices are selecteddepending on the channel condition. This selection scheme couldbe implemented by an exhaustive search technique for a smallnumber of antennas. Moreover, we develop a greedy algorithmthat achieves a near-optimal performance with much lowercomplexity compared to the (optimal) exhaustive search methodwhen the number of antennas is large. In addition, the efficacy ofpower loading across subcarriers for improved energy efficiencyin the conventional and proposed antenna selection MIMOOFDM systems is considered.

Advantages:

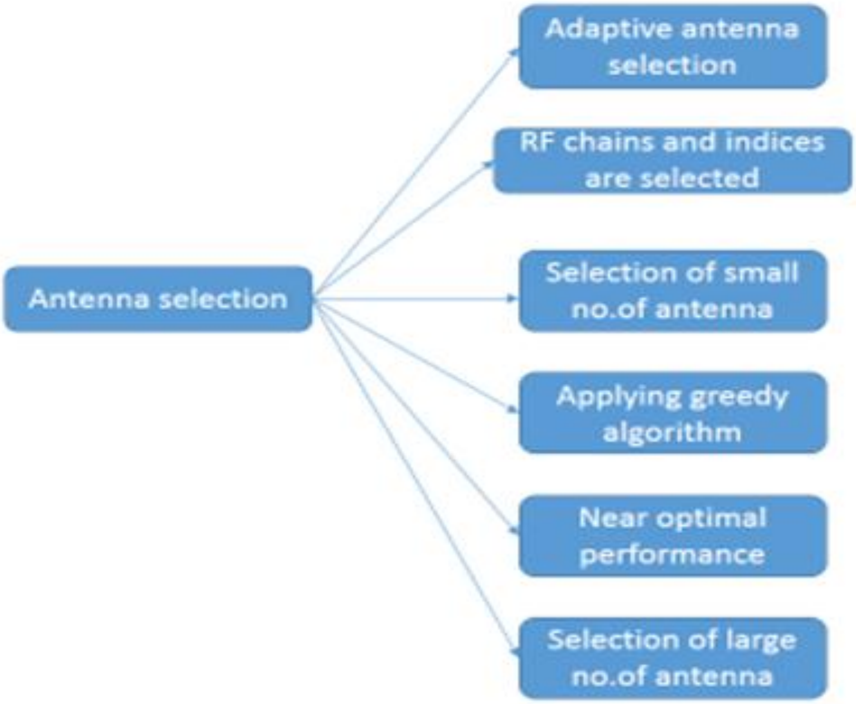
- The proposed antenna selection method achieves a better energy-efficiency performance.

- Power loading can improve energy efficiency in the low signal-to-noise ratio (SNR) region.
- The greedy algorithm can attain near-optimal energy efficiency while requiring much lower complexity compared to that with the optimal exhaustive search method.

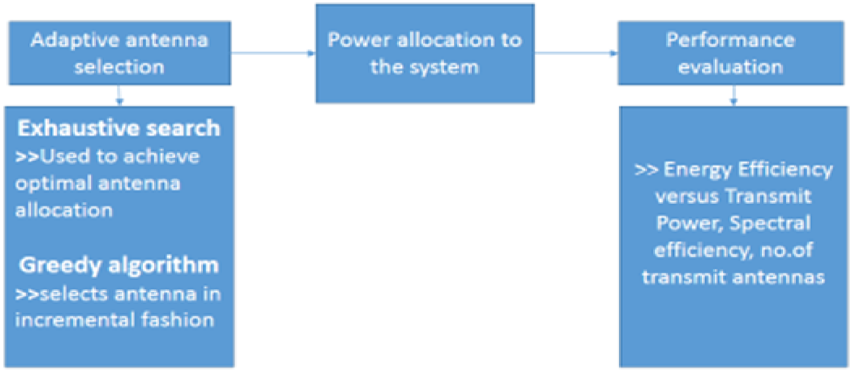
FLOW DIAGRAM



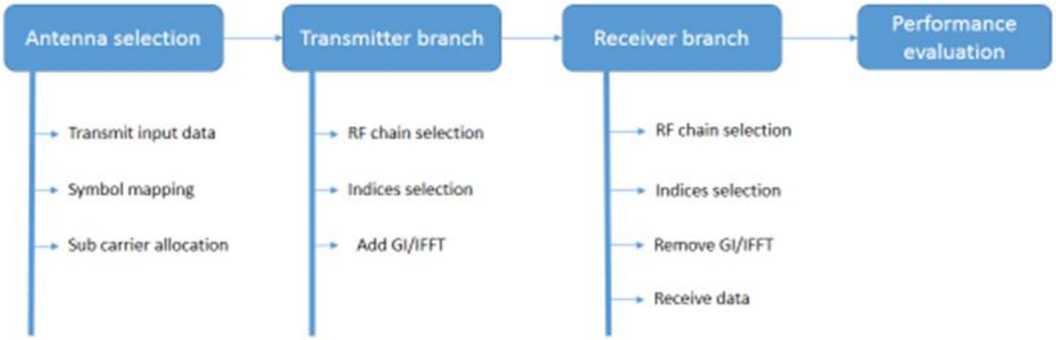
USE CASE DIAGRAM



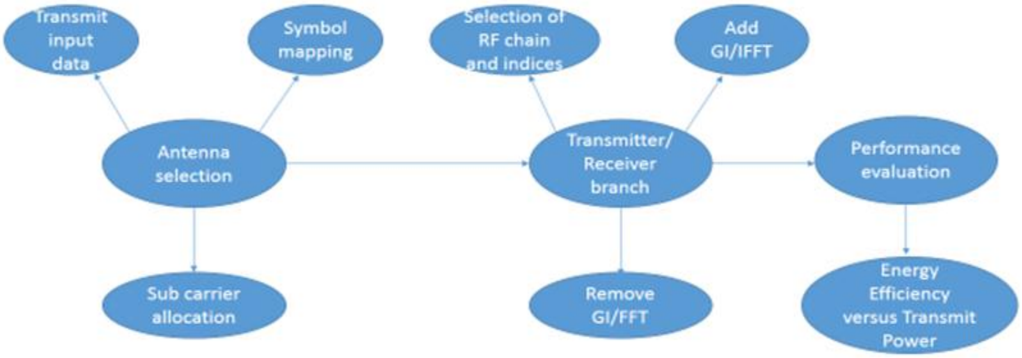
CLASS DIARGAM



SEQUENCE DIAGRAM



ER DIAGRAM



TESTING OF PRODUCT

System testing is the stage of implementation, which aimed at ensuring that system works accurately and efficiently before the live operation commence. Testing is the process of executing a program with the intent of finding an error. A good test case is one that has a high probability of finding an error. A successful test is one that answers a yet undiscovered error.

Testing is vital to the success of the system. System testing makes a logical assumption that if all parts of the system are correct, the goal will be successfully achieved. The candidate system is subject to variety of tests-on-line response, Volume Street, recovery and security and usability test. A series of tests are performed before the system is ready for the user acceptance testing. Any engineered product can be tested in one of the following ways. Knowing the specified function that a product has been designed to from, test can be conducted to demonstrate each function is fully operational. Knowing the internal working of a product, tests can be conducted to ensure that “al gears mesh”, that is the internal operation of the product performs according to the specification and all internal components have been adequately exercised.

PROPOSED METHOD

Resource Allocation Task Method for Improved Energy Efficiency

In the past several Researches, various Antenna Selection Strategies for MIMO-OFDM Wireless systems is investigated based on energy efficiency perspective to make Information and Communication Technologies more environmental friendly. One of the popular trend which are attracting a considerable amount of interest in wireless communication systems is Resource Allocation Task.

Traditionally, the Radio Resources of wireless systems are optimized in order to maximize the system throughput (or) Data efficiency where the Radio Resources and all the frames are allocated for energy efficiency Maximization. This approach provides huge energy efficiency gains over Traditional Resource Allocation schemes at the price of moderate throughput reduction.

Resource Allocation Task aims at Maximizing the Weighted sum rate of MIMO Broadcast channels. The Weighted Sum-Rate Maximization Maximizes the Weighted sum rate of all users(or) data links in a Network, is an important problem the serves as a basis for many resource management and network design problems. We are witnessing a paradigm shift from Throughput optimization methods to Energy Efficient optimization Methods.

Energy efficient metrics are naturally defined by fractional functions. As a consequence, the best tool to tackle energy efficiency maximization problems is unarguably fractional programming theory, i.e. the branch of optimization theory concerned with the optimization and properties of fractional functions. Indeed, over the last years fractional programming has become a well established tool which has been successfully used for energy-efficient resource allocation in many different wireless communication scenarios.

Basic Equation : $\mathrm{Pr\_Gi(ii):Gi(ii)}*\left(\frac{g}{N}\right)^2$

A systematic approach to maximize the energy efficiency of interference limited networks, and in particular of 5G networks, is the recently proposed framework of sequential fractional programming theory, which merges the theory of fractional programming with sequential optimization. Compared to available approaches the main advantages of sequential fractional programming are as follows:

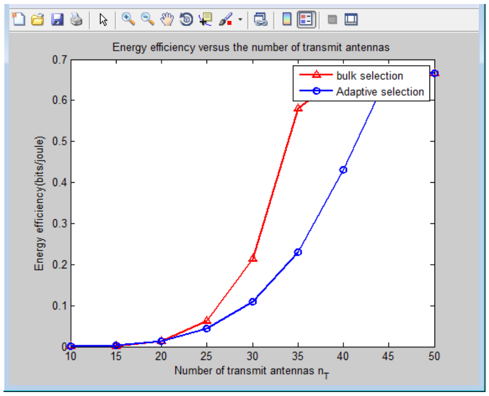
- It does not require to suppress the interference, but it is able to manage it, thereby ensuring full resource reuse and not suffering from noise enhancement effects.
- It exhibits a guaranteed convergence and a polynomial computational complexity. In addition, the obtained solution fulfills strong optimality claims.
- It is a general method which is not tailored to a specific system, but can instead be

applied to many different settings. Present Technologies and conventional approaches of wireless systems are simply not able to provide higher Date rates by scaling up the transmitting powers, and even if they were, the resulting energy consumption would cause unacceptable operating cost, determental Environmental effect.

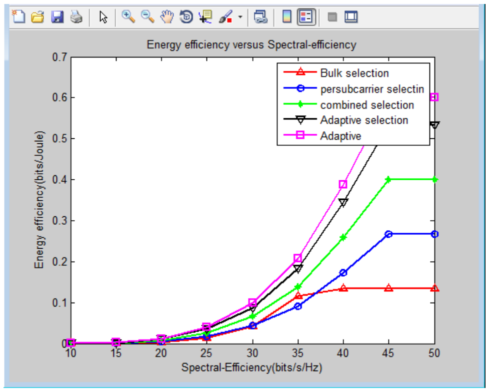
Resource Allocation includes effectively setting up equipment and operations and about increasing profits and productivity while minimizing Resource Wastage.

Energy is becoming a primary concern for the information and communication technologies community. Now-a-days, ICT is responsible for 5% of the global footprint(interms of carbon-dioxide equivalent emission)

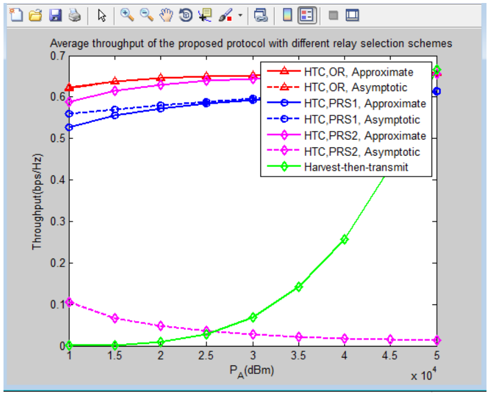
RESULTS AND SUMMERY



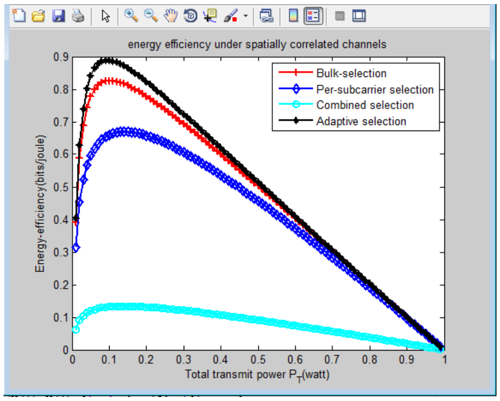
Energy efficiency versus the number of Transmit antennas



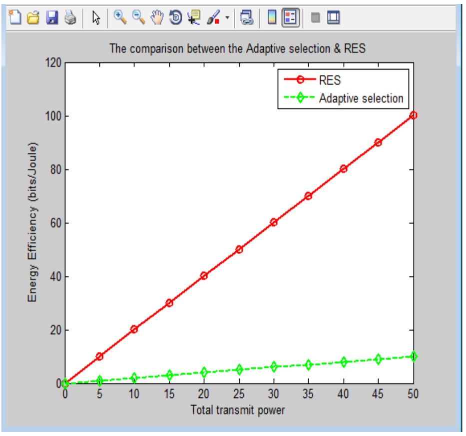
energy efficiency versus spectral-efficiency



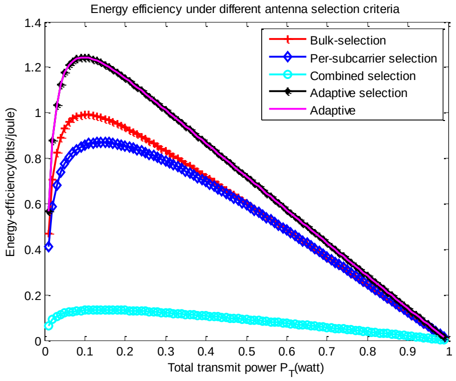
Average throughput of the proposed with Different relay selection schemes



energy efficiency under spatially correlated channels



The comparison between the adaptive selection & RES



Energy efficiency under different antenna selection criteria

CONCLUSION

This Paper has investigated the Energy Efficiency in MIMO-OFDM Systems with different Antenna Selection Strategies .Several Important Factors that affect the Energy Efficiency ,including the comparison between the actual transmitted power and the power consumed by the Transreceiver circuits, types of selection criteria , the number of antennas and the spatial correlation among antennas have been examined . Conventional and Adaptive approaches are simply not able to provide higher Data rates by scaling up the transmitting powers , and even if they were , the resulting Energy Consumption Would Cause Unacceptable Operating cost and determining environmental effect. To enhance the Efficiency, Resource Allocation Task (RAT) effectively setting up equipment and operations and about increasing profits and productivity while Minimizing Resource Wastage.

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