Review and Analysis of Spatial Channel Models in MIMO System

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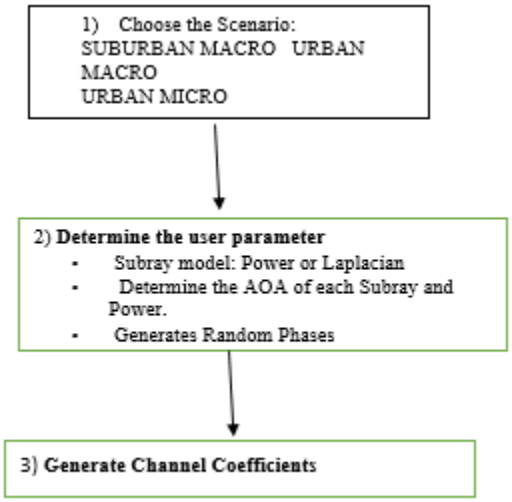
Abstract

Channel modeling is a fundamental research area in wireless communication due to the complexity of the signal propagation process. To design these new wireless systems, it is essential to use channel models. It plays a crucial role in the investigation of MIMO system capacity. The independent and identically distributed (i.i.d.) channel model has been used by researchers to derive the useful bounds of MIMO capacity. The SCM (Spatial Channel Model) is an example of a more realistic channel model. It is a standardized model developed by 3GPP-3GPP2 spatial channel model (SCM) ad-hoc groups (AHG), which are standardization bodies for 3G cellular systems. This model allows us to perform system level simulations and offers three propagation scenarios for investigation: suburban macro-cell, urban macro-cell and urban micro-cell.
Keywords- SCM, AMPS, FDMA, GPRS, B3G, CDMA

I. INTRODUCTION

Wireless communication system is the fastest growing segment of the communications industry. As such, it has captured the attention of the media and the imagination of the public. The vision of wireless communications supporting information exchange between people or devices is the communications frontier of the next few decades, and much of it already exists in some form. Wireless networks will connect palmtop, laptop, and desktop computers anywhere within an office building or campus, as well as from the corner cafe. Wireless systems continue to starving for ever higher data rates as it go on changing from one generation to another. This goal is particularly challenging for systems that are power, bandwidth, and complexity limited. However, another domain can be exploited to significantly increase channel capacity, this can be achieved by using multiple transmit and receive antennas at the transmitting and receiving section. A solution to this capacity problem emerged during the 50's and 60's when researchers at AT&T Bell Laboratories developed the cellular concept [1].The first generation (1G) cellular systems in the U.S called the Advance Mobile Phone Service (AMPS), used FDMA only for transmitting voice channels. A similar system, the European Total Access Communication System (ETACS), emerged in Europe was deployed worldwide in the 1980's. These European 1G systems are incompatible; therefore 2G came into existence. The 2G digital system is called as GSM; this system is a combination of TDMA and slow frequency hopping with frequency-shift keying for the voice modulation. These are used to support high rate packet data services; feature of this generation is SMS, Call waiting etc. GSM (Global system for mobile communication) systems provide data rates of up to 100 Kbps by aggregating all time slots together for a single user. This enhancement is called GPRS. The combination of these GSM/GPRS gives the existence of 2.5G used at 1800 MHz can be used to access internet. The third generation (3G) cellular systems are based on a wideband CDMA standard developed within the auspices of the International Telecommunications Union (ITU). In the 3rd generation (3G) and beyond-3G (B3G) wireless communication system, high data rate transmission and better quality of service are demanded. This motivates the investigation towards the full exploitation of time, frequency and more recently space domains.

II. FLOW CHART



III. COMPARISON TABLE FOR CHANNEL CAPACITY

Table 3.1: Channel Capacity

Environment	Sectors	Channel capacity(bps/Hz)
Suburban Macro cell	3-sector	16-20
	6-sector	20-24
Urban Macro cell	3-sector	15-17
	6-sector	14-16
Urban micro cell	3-sector	14-15
	6-sector	7-9

IV. RESULTS

A. Suburban Macro Cell

The Spatial Autocorrelation for 3 sector antenna and 6 sector antenna in Suburban macro cell environment at the base station is shown in Figure 4.1 and Figure 4.2.

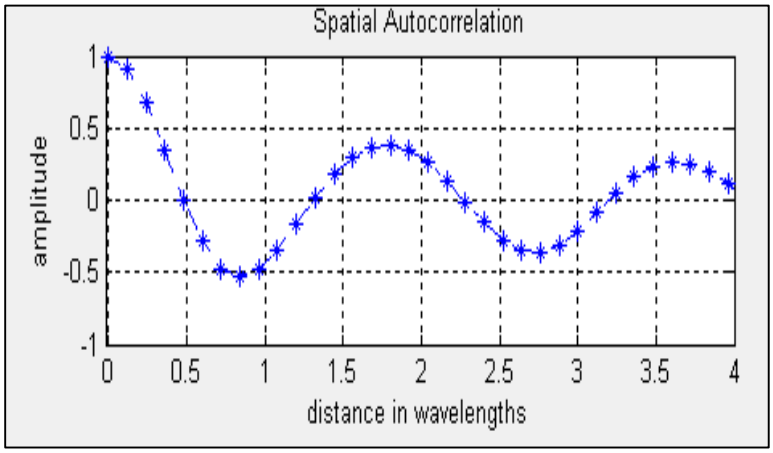


Fig. 4.1: Spatial Autocorrelation for 3 Sector Antenna

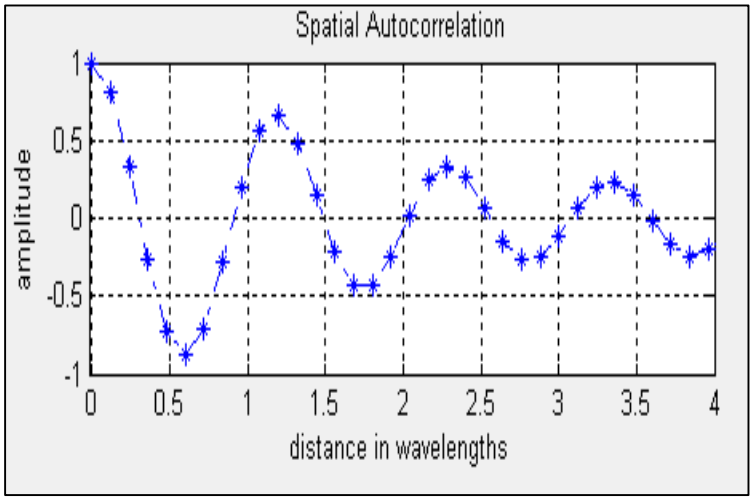


Fig. 4.2: Spatial Autocorrelation for 6 Sector Antenna

The spatial autocorrelation between the antennas is high, this gives the best transmission.

B. Urban Macro Cell

The Spatial Autocorrelation for Urban macro cell environment is shown in Figure 4.3 for 3 sector antenna and 6-sector antenna in Figure 4.4.

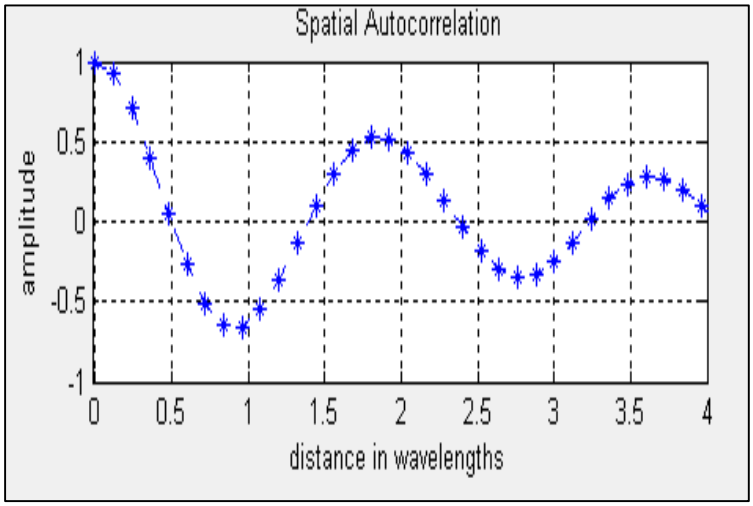


Fig. 4.3: Spatial Autocorrelation for 3 Sector Antenna

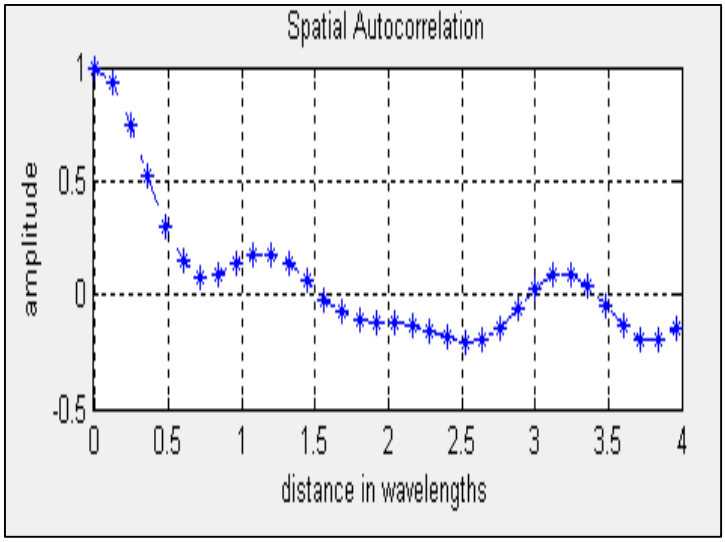


Fig. 4.4: Spatial Autocorrelation for 6 Sector Antenna

C. Urban Micro Cell

The Spatial Autocorrelation for Urban micro cell environments is shown in Figure 3.1 & Figure 3.2 for 3 sector and 6 sector antennas respectively.

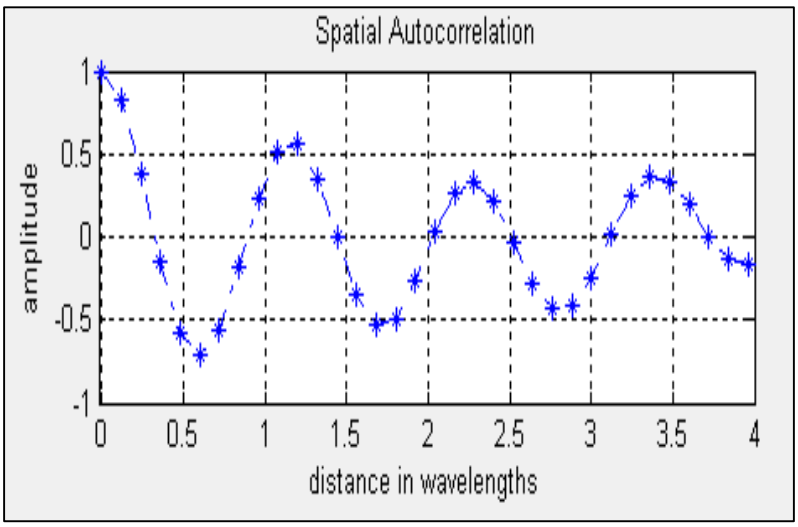


Fig. 3.1: Spatial Autocorrelation for 3 Sector Antenna

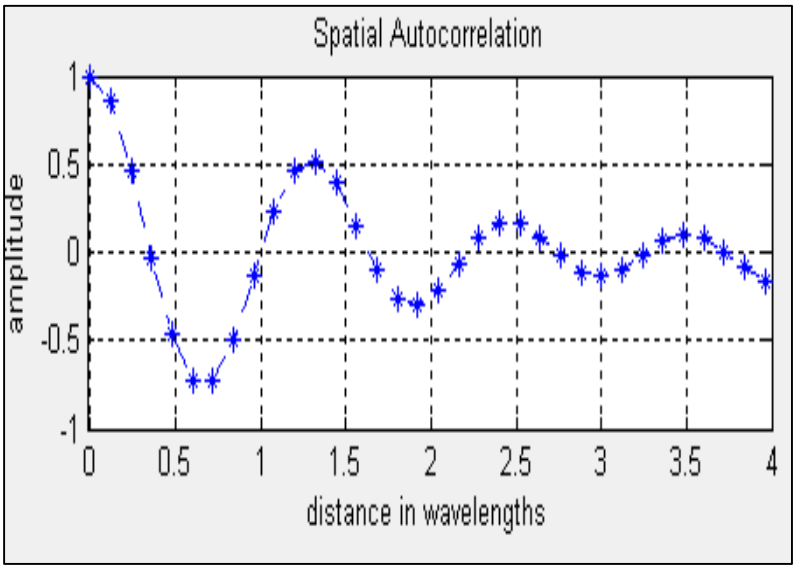


Fig. 3.2: Spatial Autocorrelation for 6 Sector Antenna

As we go on moving form environments Spatial Correlation is seen from this above results, we clearly observe that in Suburban macro- cell environment Channel capacity is more.

V. CONCLUSION

It was found out that the 3GPP SCM model tends to estimate the MIMO outage channel capacity in three environments. This is due to the static nature of the 3GPP SCM in which each signal path is modeled by 20 sub paths having fixed azimuth directions and fixed power levels. Thus, the model is characterized by relatively small spatial correlation between MIMO antennas.

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