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REVIEW ON METAMATERIAL WITH WIDE BAND ANTENNA

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INTRODUCTION

With recent and rapid developments, the wireless communications devices has grown a lot in the last decade. The demand of reliable, cheaper and compact devices are also increased with time. The wired technology becomes impractical for long distance communication. The transfer of information without any loss is possible by using radio frequency (RF) signal for both short and long distances. The radio communication device can transform the RF signal into electromagnetic (EM) waves. The RF devices is a antenna, which is used to convert the RF signal into EM wave and vice versa and defined as 'transceiver' used to efficiently radiate and receive EM signal. In wireless communication mostly used antenna is microstrip antennas due to their low profile, easy fabrication and low cost . The microstrip antenna is made on a dielectric substrate where radiating patch is made on one side and ground plane on other side. MSA suffer from several drawbacks such as, narrow bandwidth, low gain, low power handling capability, etc.

Miniaturized microwave circuits are becoming increasingly popular due to high speed communications and metamaterials .These low profile structures can be pasted over any plane or curved surface such as over aeroplanes, missiles, satellites etc. Various metamaterial techniques have been used to miniaturize microwave circuits such as using slow wave structures , using high dielectric substrates, using internal kinetic inductance, etc.

METAMATERIALS

The metamaterials improves antenna radiation properties is now widely accepted and there is a rising hope that more interesting applications are going to be introduced in the future. MTM covers a vast range of artificial structures and electromagnetic properties. A metamaterial is a material which gains its properties from its structure rather than directly from its composition. Actually, a metamaterial is a macroscopic composite of periodic or non-periodic structure, whose function is due to both the cellular architecture and the chemical composition. EM properties of materials are characterized by their parameters such as permittivity and permeability, reflective index etc.

Review on different metamaterial technologies evolving with antenna.

Antenna	Metamaterial Inspired Antenna Type	Gain(dbi)	Antenna Efficiency	Resonance frequency(GHz	FBW
CRLH SIW Slot Antenna	CRLH-Based Antenna 0^{th} and $\pm 1^{st}$ resonance modes	3.16	76.5%	11.3	1.52%
Mushroom Zeroth Order Antenna	CRLH-Based Antenna 0^{th} order resonance mode	0.87	70%	3.38	< 1%
Circularly Polarised Patch Antenna Loaded with Mushroom Structure	CRLH-Based Antenna -1^{st} resonance mode	3	72%	2.58	4.6%
ESA Based on Inductive Meander Line Structure	Metamaterial Shell-Based Antenna Electric Coupling	Not reported in literature	94%	1.37	4.1%
ESA based on inductive Z structure	Metamaterial Shell-Based Antenna Electric Coupling	Not reported in literature	80%	566.2 MHz	3%
Magnetic Coupled CLL NFRP Element	Metamaterial Shell-Based Antenna Magnetic Coupling	5.94	95%	297 MHz	1.36%

Dual-Band Circular Polarised Antenna with Two Pairs of Protractor NFRP Element	Metamaterial Shell-Based Antenna Magnetic Coupling	$5.36\ dBi$ $6.2\ dBi$	71.1% 79.2%	$1.22\ GHz$ $1.57\ GHz$	0.83% 1.53%
Microstrip-DBE Antenna	DBE based Antenna	$4.5\ dBi$	95%	$1.48\ GHz$	3.0%
Microstrip-MPC Antenna	MPC based Antenna	$6.2\ dBi$	67%	2.35	8.8%
Dual-band MZR Antenna	Mu-Zero Resonance Antenna	$2.9\ dBi$	86%	7.3	2.8%,
Spherical Wire Split Ring Antenna	SRR Resonator Embedded Antenna	Not reported in literature	73%	403MHz	Not reported in literature
Inductively-Fed Vertical SRR Antenna	SRR Resonator Embedded Antenna	$2.05\ dBi$	68.1%	2.85	20.1%
Dual-Band, Dual Polarised CSRR Embedded Antenna	CSRR Resonator Embedded Antenna	$-2.13\ dBi$ $5.04\ dBi$	22.8% 74.5%	2.41 3.82	0.91% 1.76%
Triple-Band Antenna with polarization	CSRR Resonator Embedded Antenna	$0.27\ dBi$ $3.31\ dBi$ $4.45\ dBi$	43.7% 69.8% 75.5%	$2.4\ GHz$ $2.8\ GHz$ $3.4\ GHZ$	1.61% 3.27% 3.08%
RIS Loaded Patch Antenna	Meta-Surface Loaded Antenna	$4.5\ dBi$	90%	$1.92\ GHz$	6.7%

Patch Antenna with AMC Ground Plane & PRS Superstrate	Meta-Surface Loaded Antenna	19 dBi	Not reported in literature	14.2 GHz	2%

CONCLUSION

The increasing demand for microstrip antennas has led to the development of many wideband and ultra-wide band resonator and metamaterials. They have greater design flexibility, ease of fabrication, low conductor loss, high efficiency, wide bandwidth, and compact size. Metamaterial can be excited by various feeding mechanisms and integrated with many devices.