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Summary and Conclusions

The UWB technology offers the solutions for WPAN and WBAN systems due to its high data transmission capacity at very low power level. Besides, the antenna being at the front end of any communication system, its design and development for wideband scenario remains a challenging task. Therefore, in the thesis, different types of UWB antennas have been designed using fractal geometry in order to achieve different objectives such as wideband, miniaturization, good radiation characteristics, etc.

It is demonstrated in the various designs that application of fractals in the antenna design helps to achieve desired miniaturization and wideband phenomena with enhanced radiation characteristics due to its self-similarity and space-filling properties. The evolution process of fractals has been explained using IFS algorithm. Based on the work presented in the thesis, the following key contributions can be drawn:

Firstly, a number of novel UWB antennas are designed using Minkowski-like, Minkowski, Sierpinski and Koch fractal geometries and their characteristics are investigated. Fractal geometries are applied at edges of fractal monopoles as well as in the ground plane, which helps to achieve desired miniaturization and wideband phenomena with improved radiation characteristics.

Secondly, an analytical mathematical formula is presented to evaluate the effective parametric length and the area for a specified iteration. In addition, mathematically it is demonstrated that application of fractals in design helps in miniaturization significantly.

Thirdly, compact UWB antennas with band rejection characteristics are presented. In order to achieve the band rejection characteristics, fractal and C-shaped slots are applied in the design. These prototypes are fabricated and measured to validate the proposed concept.

Fourthly, reconfigurability is introduced in antenna design in order to utilize the spectrum efficiently. Reconfigurability in the context of band rejection as well as operating bandwidth, using p-i-n diodes, capacitors and resistors, in the fractal UWB antenna design is demonstrated for next generation CR systems.

Fifthly, compact UWB MIMO antennas have been presented using Minkowski and Koch fractal geometries to overcome multipath fading. It is demonstrated that application of fractals in UWB MIMO antenna design helps to achieve the desired miniaturization and enhanced radiation characteristics.

Finally, the operating behavior of fractal UWB antenna and fractal UWB MIMO antenna are studied, in the proximity of the human body, in the context of on-body and off-body WBAN applications.

Therefore, we can conclude that the objective of this research is achieved with desired antenna characteristics. The possible extensions of the above works that can be done in the future are listed below:

- Application of other fractal geometries in the wideband antenna design.
- Investigation of the fractal UWB antennas in the design of UWB antenna array to have high gain for Ground Penetrating Radar (GPR) and medical imaging applications.
- Explore the possibilities of novel fractal UWB antennas for WBAN Application on thin and/or flexible substrates.
- Explore the possibilities of wideband filters using fractal geometries.

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