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# APPLICAION OF MICROWAVE IN BIOMEDICAL SCIENCE

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Future ways in medical applications of microwave technique and technology can be seen in development of new diagnostic and imaging methods based on high frequency EM field. A considerable importance for the future can be specified for the following methods such as microwave breast cancer detection, and treatment with localized high power used in ablation of the heart and liver benign prostate hypertrophy angioplasty, and others. A very brief outline of biological effects of RF/microwaves and associated issues is given as backfround to the applications.

Keywords: Thermography, microwave, cancer detection and Irradiation.

## Introduction

Microwaves are electromagnetic waves that have a frequency range from around 0.3 GHz (there is no actual specified lower frequency limit) to 300 GHz with corresponding wavelengths ranging from 1m to 1mm.as shown in fig1**.**

The word Microwave means very short wave, which is the shortest wavelength region of the radio spectrum and a part of the electromagnetic spectrum.

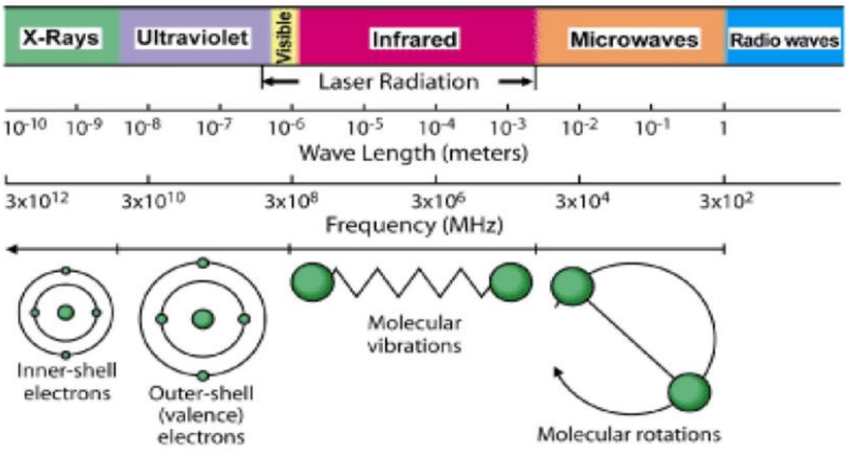


**Fig.1: Electromagnetic spectrum.**

## Electromagnetic spectrum

Radio waves, microwaves, infrared and visible light can be used for communication.

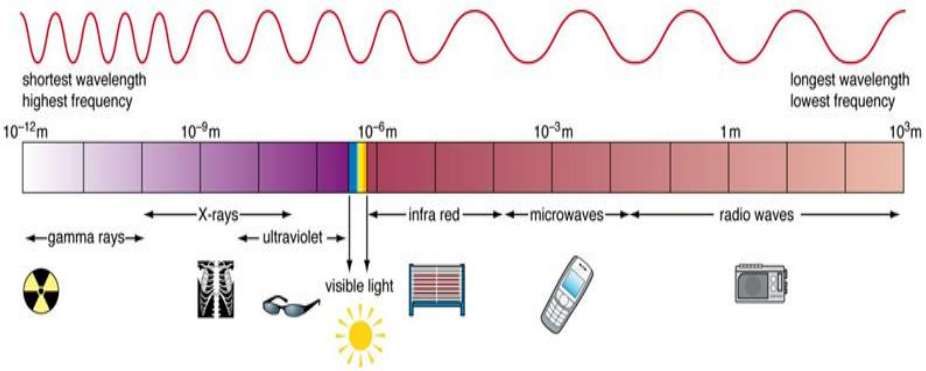


**Fig. 2: Electromagnetic spectrum.**

**Properties of Microwaves:**

1- Microwave is an electromagnetic radiation of short wavelength**.**

2- The frequencies of microwaves are those between 1GHz and 300GHz.

3- They are not reflected by ionosphere.

4- They can reflect by conducting surfaces just like optical waves since they travel inupright line.

5- Microwaves are easily attenuated within short distances.

6- Microwave currents flow through a thin outer layer of an ordinary cable.

**Advantages of technology:**

1- Broad domain of frequencies.

2- Ability to focus the energy.

3- Variety of simulation tools.

4- Comparatively low cost.

5- Low if any health risk.

6- Human characteristics:

* Differences in tissue.

* Properties (normal/tumor).

1. Spatial resolution.

2- Penetration depth

3-Electromagnetic interference

4- Human characteristics complex patterns of fields inthe body, scattering Individual anatomical differences

**Limitations of technology**

**Applications of microwaves in medical:**

Recent trends in microwave medical applications are to study the possibilities to develop newdiagnostics based on EM field resp. on microwace technique. A significant importance forthe future can be identified for the next methods:

* (Magnetic resonance (will not be a part of our project).

* Microwave tomography .

*Microwave radiometry.

* Measurement of complex permittivity.

* Imaging in the Terahertz waves band.

*Microwave diagnostic radar.

**Microwave tomography:**

Transmitted waves recorded at a number of locations; repeated forvarious transmitter positions Measured data compared to model forward problem: material properties estimated, transmitted waves at the measurement points computed forward problem solution and measurements.

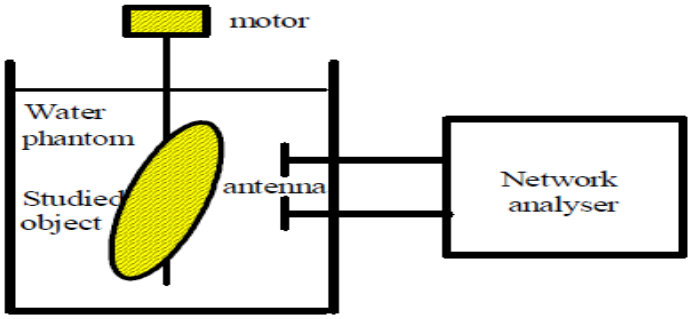


**Fig. 3. Schematics of experimental setup of microwave tomograph for biomedical imaging**

**Microwave breast tumor detection:**

Breast cancer detection and treatment response monitoring are areas where microwave imaging is becoming a promising alternative/complementary technique to current imaging modalities, mainly due to the significant dielectric propertycontrast between normal and malignant breast tissues**.**

**Microwave radiometry:**

Microwave radiometry is based on measurement of a very weak EM signal, which radiateany object (e.g. people), whose temperature is superior to absolute zero [1]. It is based onutilization of so-called Planck radiation law. Interest in

microwave radiometry is given bypossibility of its utilization at diagnostics of cancer and also of inflammatory disorder (e.gappendicitis, arthritis, atp.) because tumors and inflammatory processes causes temperaturerise.

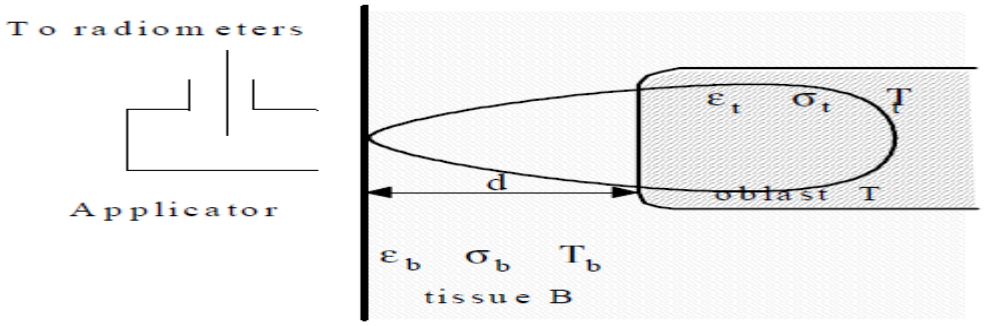


**Fig.4: Principals of imaging by a microwave radiometer.**

**Conclusions:**

Applications of microwaves in medicine can be divided into three parts :

* Microwave technique used for the treatment of patients (with the use ofeither thermal or non-thermal effects – sometimes both of these types of effects can play its role.

* Microwave technique used for diagnostics of diseases (e.g. by aid of permittivity measurements attenuation measurements and very prospective in the nearfuture can be a microwave tomography).

*Microwave technique used as a part of a treatment or diagnostic system (e.g. linear accelerator).

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