

## A MICROWAVE RADIOMETER FOR MEDICAL APPLICATIONS

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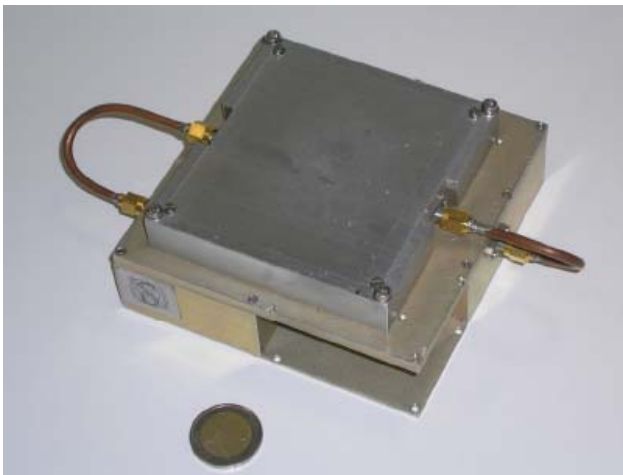
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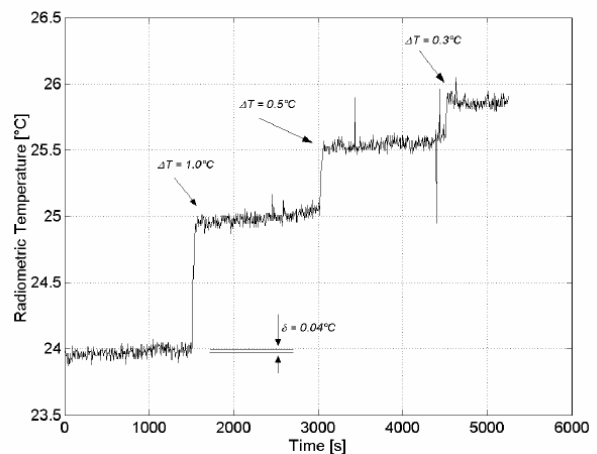
Microwave radiometry is investigated for non-invasive measurement of subcutaneous temperature as well as for detection of pathologies that are characterized by the presence of local thermal anomalies [1]. First type applications have been proposed for the monitoring of the temperature in oncological hyperthermia [2] and during hypothermia treatment of neonatal ischaemia [3]. The diagnostic application has been explored mainly for detection of mammalian cancer [4], [5] as a complementary technique to mammography.

A two-channel radiation-balance microwave radiometer has been designed and assembled. In view of the medical application, a sensitivity better than 0.1 °C was specified for 1s integration time. Immunity to reflectivity changes in the range between 0 and 0.25 was also specified. The size of the microwave unit has been kept small in order to allow its positioning close to the antenna and the sensed body (Fig.1). The radiometer besides has some interesting features. Among them we quote: *i*) the use of high performance PIN switches, which show low insertion losses and high insulation due to a resonant scheme; *ii*) miniaturized front-end which employs MMIC and microwires on bare chips; *iii*) use of COTS devices in order to have a low cost; *iv*) radiometer operation and data acquisition supervised by a microcontroller, in order to have flexibility and capability of adopting further measurement procedures.

A record of radiometric data is given in Fig. 2. In this experiment a matched load, connected to the radiometer input by a short coaxial cable, is immersed in a water tank whose temperature is controlled by a thermostat. Bath-temperature steps are recognized by the radiometer over instrumental noise, whose rms value is about 0.05 °C for 5 s of integration time. In this paper, recent advances on potential applications to the visibility of a breast malignancy are discussed.



**Fig. 1** Tor Vergata radiometer microwave unit.



**Fig. 2** Radiometer data record in the presence of temperature steps.