# Improved Resonant Cavity Techniques to Measure Dielectric Constant of Seawater at L-band

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This paper describes recent results obtained when using a transmission resonant cavity technique for the measurement of the dielectric constant of seawater as a function of its salinity and temperature at 1.413 GHz. These measurements will be useful in algorithm development for sensor systems such as SMOS and Aquarius. These satellite instruments, which will monitor salinity from space in the near future, require an accurate relationship between salinity/temperature and seawater dielectric constant. Our objective is to determine the dependence of the dielectric constant of seawater on salinity and on temperature more accurately than measurements performed in the past by taking advantage of modern instrumentation.

The measurement system consists of a brass microwave cavity that is resonant at 1.413 GHz. The seawater is introduced into the cavity through a capillary glass tube having an inner diameter of 0.1 mm. The diameter of the tube has been made very small so that the amount of seawater introduced in the cavity is small – thus maintaining the sensitivity of the measurement. The change in resonant frequency and the change in cavity Q can be used to determine the real and imaginary parts of the dielectric constant of seawater introduced into the slender tube. The microwave measurements are made by an HP8722D network analyzer. The cavity has been immersed in a water/ethylene-glycol bath which is connected to a Lauda circulator. The circulator keeps the brass cavity at a temperature constant to within 0.01 degrees. The system is automated using a Visual Basic program to control the analyzer and to collect the data.

The stability of the cavity frequency as a function of time is an important factor in measurement repeatability. Empty-cavity tests over a 24 hour period have shown a cavity resonance frequency drift of 3 to 5 kHz. The drifts have been correlated to the changing laboratory temperature of 6 to 7 degrees C over the same time span. The improved *repeatability* of measurements in a temperature controlled laboratory will be compared to previous tests conducted with no room temperature control. Sample tube blockage by dirt particles has been addressed by employing methods used in gas chromatography. This new setup will be described. Finally, recent seawater measurements as a function of temperature and salinity will be discussed along with their *repeatability* statistics. The seawater dielectric constant derived from these measurements will be compared with values found in the literature.

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