4.5.3 Connection between device, liquid, and probe parameters

The electric parameters of the simulation liquid are frequency dependent. Unluckily, this frequency dependency in the homogeneous simulation liquid is different than in the complex cellstructure of the simulated tissue. Since each solution can simulate the tissue only within a limited frequency range, several mixtures are necessary to cover the total MTE frequency range. Within a frequency bandwidth of at least 20%, the same solution can be used with small errors in the SAR. However, the measured parameters at the actual frequency should be used in the software (see RG: 2.3 Medium).

The DASY3 software checks the selected solution against the device frequency to prevent incorrect combinations which could lead to undetected measurement errors. To that purpose, each dataset for the media includes frequency range settings. If the frequency of the selected device is not within the range of the selected media, the system will issue an error message. It is highly recommended to use different media datasets for different frequencies, even for the same liquid. If one liquid is used for 835MHz and 900MHz two datasets with the corresponding parameters should be used (e.g., with frequency ranges 800 - 850 MHz and 870 - 920 MHz). The liquid parameters should be remeasured and adjusted in the software regularly (see RG: 2.3 Medium).

The probe conversion factor (and boundary effect) depends on the frequency and the liquid parameters. For each dosimetric probe, many different sets of conversion factors and boundary correction data can be defined (RG: 2.6.1 E-Field Probe). Each set includes range settings for permittivity, conductivity and frequency. The probe conversion factors can be selected manually or automatically (RG: 2.6.1 E-Field Probe). In the (recommended) automatic selection mode, the software searches for the first conversion factor in the list, whose permittivity and conductivity and frequency range covers the selected device frequency and liquid parameters. If no valid conversion factor can be found, the system will issue an error message when trying to measure SAR. The same error message appears if the manually selected conversion factors do not correspond with the device or the media.

Note: The system automatically selects the first valid conversion factor. If you define conversion factors with a reduced frequency and parameter range, make sure that this range is not already covered by an other set further up in the list.

The conversion factors are determined during probe calibration. SPEAG probes are by default calibrated at 900MHz and 1800MHz in brain simulating tissue. The range settings in the probe configuration file are selected to guarantee the specified probe uncertainties. If you want to perform SAR measurements in other liquids (e.g., 835MHz muscle tissue), the DASY3 system will complain. There are several ways to overcome the problem:

- Increase the range settings in the probe document, leaving the conversion factors as they are. This will permit the measurement, although with increased uncertainty. For small changes in the parameters or frequency the error is small (see box below).
- Add a new conversion factor set for the new liquid or frequency. The conversion factor can be estimated from the existing conversion factors (see box below).
- Order special calibrations for the probe.

The following sensitivities of the conversion factor can be used to estimate the conversion factor for other frequencies or media. They are assessed from special calibrations with the ET3DVx probe series. (They cannot be applied for other probe types!)

For frequency changes within the same media (not the same media parameters, they change also with the frequency and must be adjusted in the media settings!):

- In brain and muscle tissue between 750MHz and 1GHz, the conversion factor decreases approximately 1.3% per 100MHz frequency increase.

- In brain and muscle tissue between 1.6GHz and 2GHz, the conversion factor decreases approximately 1% per 100MHz frequency increase.

For muscle tissue around 900MHz (permittivity about 30% higher and conductivity about 15% higher than brain tissue):

- The conversion factor in muscle tissue is approximately 3% lower than for brain tissue for the same frequency.

For example:

An ET3DVx probe with a conversion factor 6.0 for 900MHz brain gives a conversion factor of 5.87 for 835MHz muscle tissue.