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CONTENTS

Release Notes for v 3.0 (June 2016)

Release Notes for v 2.1 (May 2006)

Release Notes for v 2.0 (April 2006)

Release Notes for v 1.0 (Initial Release, September 2004)

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WHAT'S NEW:

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v 3.0:

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Spektr v 3.0 includes an updated spectral model [TASMICS], a spectral tuning function [*spektrTuner*( )], improved filtration functions [*spektrBeers*( ) and *spektrBeersCompoundsNIST*( )], new spectral characteristic functions [*spektrAirKerma*( ) and *spektrFluencePerAirKerma*( )], enhanced UI functionality, and a bug fix.

**TASMICS:**

The spectrum generating function, *spektrSpectrum*( ), is updated to include the Tungsten Anode Spectral Model using Interpolating Cubic Splines (TASMICS) in addition to the model in previous spektr versions (Tungsten Anode Spectral Model using Interpolating Polynomials (TASMIP)). Backwards compatibility was preserved by allowing users to specify the spectral model as either TASMICS or TASMIP (default model = TASMICS). Spektr v 3.0 generates spectra with improved energy resolution as a result of including the Tungsten Anode Spectral Model using Interpolating Cubic Splines (TASMICS).

An optional argument to generate a TASMICS spectrum that best matches a TASMIP spectrum at the same tube potential was implemented to match the Monte Carlo based TASMICS spectrum to physical measurements.

**spektrTuner:**

A function to compute the filtration that provides the best match in either mGy/mAs or mR/mAs of a computed spectrum to a measured spectrum was created. The function, named *spektrTuner*(), is outlined below:

*spektrTuner*([spectrum]*,*[mAs]*,*[measurement],SDD *…*

[addFilt]*,* measureFlag,[estimAl, estimW])

where spectrum([150 x 1]) is generated from *spektrSpectrum*() at the measurement kV. The argument[measurement]([M x 1], units of mGy or mR) stores air kerma or exposure measurements for each [mAs]([M x 1] units of mAs) setting. The argument SDD stores the source-to-detector distance (mm). Added filtration in the system is stored in the [N x 2] [addFilt] vector, where the first column contains the atomic number of the filter element and the second column contains the thickness (mm) of that element. measureFlag denotes the type of measurement contained in [measurement] and it accepts either, ‘airkerma’ or ‘exposure’ as a string. The optional [estimAl, estimW] argument allows the user to specify the estimated inherent filtration necessary to match the computed and measured spectra. For example:

computes the inherent filtration necessary for a computed spectrum to match a 70 kV normalized TASMICS spectrum with exposure measurements of 0.54 mR at 0.2 mAs, 2.46 mR at 1.5 mAs, and 3.15 mR at 2 mAs with 2 mm Al and 0.2 mm Cu added filtration at 744.8 mm away from the detector.

**Filtration functions:**

Custom filtration functions (i.e. *spektrBeers*( ) and *spetkrCompounds*( )) are improved to accept both strings (i.e. element symbol and compound name, respectively) and numerical values (i.e. filter atomic number and compound number as specified in *spektrCompoundList.m*, respectively).

The data underlying *spektrBeers*( ) and *spektrCompounds*( ), (*spektrMuRhoElement*s*.mat* and *spektrMuRhoCompound*s*.mat*, respectively) were updated to contain attenuation coefficients measured at the average energy of each energy bin in a TASMICS spectrum to reduce errors due to interpolation of the attenuation coefficient data. *spektrMuRhoElement*( ) and *spektrMuRhoCompound*( ) were also updated to output the linear attenuation coefficients and density for the specified material when a scalar value is inputted. When *spektrMuRhoCompound*( ) is called with a [Nx2] vector containing the elements composing the compound in the first column and the quantity of each element in the second, the mass attenuation coefficient alone is returned.

**Spectral Characteristic Functions:**

Two new functions, *spektrAirKerma*( ) and *spektrFluencePerAirKerma*( ), were created to update *spektrExposure*( ) and *spektrFluencePerExposure*( ) to output air kerma (mGy/mAs) and fluence per air kerma (photons/mm2/mGy) respectively.

**UI Improvements:**

Improved plotting in the spektr 3.0 user interface includes automatic rescaling, panning, zooming, and a data cursor.

Within the GUI, copper filters can now be applied within the x-ray tube settings panel.

A pushbutton was added to clear user input fields and variables in memory.

Load and save functionality incorporate folder browsing to specify the file location.

**Other Improvements:**

The inherent filtration of the spectrum can be adjusted by changing the tube preset parameters in *tubeSettings*( ).

Finally, the Spatial Filter and all Excel file dependencies were removed and an error in the densities of Gd2O2S and GaAs was corrected.

v 2.1:

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Spektr v 2.1 includes two bug fixes for the GUI button “Equiv. mmAl”. Previous versions provided incorrect results for added filtration containing compounds, caused by a bug which replaced the attenuation coefficients for the compounds C=1-20 with coefficients from the *elements* Z=1-20. In addition, the GUI button was modified to report equivalent mmAl corresponding to the generated spectrum (i.e., based on the kVp, kV ripple, and mmAl settings), instead of being hard-coded to a 100 kVp spectrum as in previous versions.

v 2.0:

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The latest release of spektr (v 2.0) is a “speedy” version of the initial release (v 1.0). It provides equivalent functionality to v 1.0, but with a boost in processing speed by factors of (25-150) for the basic spektr functions. For existing users of spektr, the functional interface is the same. The reduction in processing time was produced by loading all the Excel data (containing tables of physical constants) into MATLAB .mat files to avoid the speed bottleneck resulting from the repeated use of the function “xlsread”. The original .xls files are included as reference, along with the MATLAB script “spektrXLS2MAT.m” that can be used to convert any future updates to physical data in the .xls files into the .mat files.