A general method for deriving X-ray spectra for 25 kV to 25 MV from transmission methods in different materials

A general method is presented for deriving x-ray spectra for any energy from transmission measurements in different materials such as aluminum, copper, lead and water. Since the typical transmission measurement involves exposure, we derive the relative exposure per energy interval with this method. The method uses a narrow beam attenuation curve down to a few percent transmission. The number of measurement points in the transmission curve is equal to the number of energy bins in the output spectrum. An assumed relative exposure spectrum is used as input for the transmission matrix with each element being an exponential attenuation factor for filter thickness X_i and photon energy E_i. The transmission for any filter thickness X_i is calculated and compared to the actual transmission at that filter thickness. The relative exposure in the assumed input spectrum is now perturbed in a positive and negative fashion at each photon energy, and a new transmission is calculated. If the difference between the new transmission and the measured transmission decreases, the perturbed exposure is selected as the exposure value for that energy. Examples from mammography, 25 kV, to megavoltage therapy, 25 MV, using both measured attenuation curves by the authors and curves taken from the literature will be shown.