DIGITAL SIGNAL PROCESSING APPLICATION IN NUCLEAR SPECTROSCOPY

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Digital signal processing algorithms for nuclear particle spectroscopy are described along with a digital pile-up elimination method applicable to equidistantly sampled detector signals pre-processed by a charge-sensitive preamplifier. The signal processing algorithms provided as recursive one- or multi-step procedures which can be easily programmed using modern computer programming languages. The influence of the number of bits of the sampling analogue-to-digital converter to the final signal-to-noise ratio of the spectrometer considered. Algorithms for a digital shaping-filter amplifier, for a digital pile-up elimination scheme and for ballistic deficit correction were investigated using a high purity germanium detector. The pile-up elimination method was originally developed for fission fragment spectroscopy using a Frisch-grid back-to-back double ionisation chamber and was mainly intended for pile-up elimination in case of high alpha-radioactivity of the fissile target. The developed pile-up elimination method affects only the electronic noise generated by the preamplifier. Therefore, the influence of the pile-up elimination scheme on the final resolution of the spectrometer investigated in terms of the distance between piled-up pulses. The efficiency of developed algorithms compared with other signal processing schemes published in literature.

Keywords: x- and gamma-ray spectroscopy, computer data analysis, ionization chambers, interpolation; curve fitting, numerical differentiation and integration, integral and integrodifferential equations.