recorded for widely different times. The statistical "noise" evident in the lower-count spectra can obscure weak peaks from true gamma-ray sources that may be present, so the performance of analysis algorithms will be sensitive to the times allocated to the measurements.

PROBLEMS

18.1 How many pulse height channels should be provided to represent adequately the full spectrum from a system with 0.3% pulse height resolution?

18.2 Two peaks in a recorded pulse height spectrum are separated by 24 channels. Assuming a perfectly linear system, by how many channels will this separation change if the gain of the amplifier supplying the MCA is decreased from 1000 to 750, and the zero offset of the MCA is increased from 10 to 15 channels?

18.3 A Wilkinson-type ADC has a conversion gain of 2048 channels and a maximum conversion time of 25 μs. At what frequency must the oscillator operate?

18.4 How many stages are required in a successive approximation ADC to achieve a conversion gain of 4096 channels?

18.5 Why is it not possible to apply the formulas for dead time corrections developed in Chapter 4 to correct for losses in an MCA using a linear ramp ADC?

18.6 An MCA using a Wilkinson-type ADC operating at 80 MHz has a pulse storage time of 2.5 μs.

(a) What is the analyzer dead time for pulses stored in channel number 300?

(b) What will be the fractional dead time for a true pulse rate of 5000/s if the average pulse amplitude falls in channel number 220? Repeat for a true rate of 50,000/s.

(c) If the analyzer is set to record for a live time of 10 min, how much actual time will elapse under the conditions of part (b)?

18.7 Equally spaced pulses of fixed amplitude are generated at an adjustable frequency in an electronic pulser. They are supplied to an MCA with a dead time of 90 μs for the size of pulse involved. Sketch a plot of percent dead time losses versus pulser frequency over the range from 10 to 30 kHz.

18.8 The coincident outputs from two detectors are to be recorded in a two-dimensional multiparameter analyzer. If the detectors have pulse height resolutions of 0.5 and 2.5%, estimate the total number of memory locations needed to record faithfully the coincident output of both detectors over their full span.

18.9 A pulse height spectrum is recorded in an MCA by counting a source for a given live time, and then removing the source and subtracting background for an equal live time. In the upper region of the spectrum, the source contributes nothing so the average channel content after subtraction should be zero. Due to the influence of counting statistics, however, some channel-to-channel fluctuation about zero is observed. If the background is about 300 counts/channel over this region of the spectrum, what deviation from zero should be expected in a typical channel?

18.10 One commonly used method to sense the position of a peak superimposed on a continuous background is to take second differences in the multichannel data. To illustrate the behavior in the vicinity of a peak, make a plot of the second derivative of a Gaussian peak across its full width.

18.11 The following is a portion of a gamma-ray pulse height spectrum recorded using a germanium detector and MCA:

Channel Number	Counts	Channel Number	Counts
711	238	720	1625
712	241	721	1739
713	219	722	1412
714	227	723	901
715	242	724	497
716	280	725	308
717	409	726	256
718	736	727	219
719	1190	728	230

It can be assumed that the data consist of a constant background plus a Gaussian-shaped peak.

(a) Plot the data and estimate the constant background level. Find the net number of counts under the peak by direct summation. Estimate the centroid location of the peak (to the nearest tenth of a channel). Estimate the FWHM of the peak.

(b) Fit the net counts in the region of the peak with a Gaussian function using an available software fitting routine. Obtain the resulting peak area, centroid, and standard deviation, and compare with the results of part (a).