Singapore Polytechnic
School of Electrical and Electronics Engineering
ET0104 Embedded Computer Systems DECC 3FT/4EO

Tutorial 7 DAC/ADC

1. -DAC elements: resister network, current/voltage, reference voltage, output amplifier.
   -DAC *voltage* output is directly proportional to the input digital value.

2. Resolution: 4.5V/255 = 17.6mV
   For a ½ wave rectified wave, the equation is: V=2sin(angle).
   Since there are 6 points, each sample occupies 360/6 = 60 deg. 360 for 1 cycle.
   But only values from 0 to 180 have any value.

Angle	0	60	120	180	240	300	360
Sine	0	0.866	0.866	0	0	0	0
Analog	0	1.732	1.732	0	0	0	0
Digital	0	98	98	0	0	0	0

For 300Hz, the time period is 10/3 ms. Divide by 6 again, we get the time delay between two points is 0.56ms.

For comparison, using 12 points

Angle	0	30	60	90	120	150	180	240	300	360
Sine	0	0.5	0.866	1	0.866	0.5	0	0	0	0
Analog	0	1	1.73	2	1.73	1	0	0	0	0
Digital	0	56	98	113	98	56	0	0	0	0

3a) Output is a rising saw-tooth wave, the output frequency is about 40KHz/1024 = 39Hz.
b) Counts down: the output waveform will be a falling saw-tooth, same freq.=39Hz.
c) Count up & down: output is a triangle waveform, frequency is 40KHz / 2048 = 19.5 Hz.

4.a) (4V/64H) * B9H = 7.4V

b) 10V/40mV = 250, so 8 bit DAC is enough. Also:
   Res = 40 mV =< 10V/(2**(# bits) - 1)
   Taking logs, # bits >= lg 10 / lg 40 mV = 7.97 ~ 8.

5. Integrating : slow, cheaper, accuracy: medium, low cost
   Counter Ramp : may be faster than integrating, cheap, medium accuracy and cost
   Successive Approx : faster than integrating& counter ramp, medium accuracy and cost
   Sigma-Delta : greater precision (more bits)/accuracy, medium cost
   Parallel / Flash : fastest, expensive