How to Generate ECG Waveforms

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Function/Arbitrary Waveform Generator

This video shows how to generate an ECG waveform using the LeCroy WaveStation 2012.

ecg-function-generator.mp4

Digilent Analog Discovery Waveform Generator

The following script can be used to generate an ECG waveform on a Digilent Analog Discovery:

```
// Constants for waveforms
var A_P = 0.2;       // P-wave amplitude (increased for realism)
var mu_P = 0.15;     // P-wave center (earlier position)
var sigma_P = 0.03;  // P-wave width

var A_Q = -0.2;      // Q-wave amplitude (swapped with S)
var mu_Q = 0.45;     // Q-wave center
var sigma_Q = 0.015; // Q-wave width

var A_R = 1.0;       // R-wave amplitude (unchanged)
var mu_R = 0.5;      // R-wave center
var sigma_R = 0.02;  // R-wave width
```

```
var A_S = -0.3;      // S-wave amplitude (swapped with Q)
var mu_S = 0.55;     // S-wave center
var sigma_S = 0.015; // S-wave width

var A_T = 0.4;       // T-wave amplitude (increased for realism)
var mu_T = 0.95;     // T-wave center (further shifted to extend ST segment)
var sigma_T = 0.05;  // T-wave width

// Euler's number (approximation)
var E = 2.71828;

// P-wave
var P_wave = A_P * pow(E, -pow((X - mu_P), 2) / (2 * pow(sigma_P, 2)));

// QRS complex as a combination of Q, R, and S waves
var Q_wave = A_Q * pow(E, -pow((X - mu_Q), 2) / (2 * pow(sigma_Q, 2)));
var R_wave = A_R * pow(E, -pow((X - mu_R), 2) / (2 * pow(sigma_R, 2)));
var S_wave = A_S * pow(E, -pow((X - mu_S), 2) / (2 * pow(sigma_S, 2)));
var QRS_wave = Q_wave + R_wave + S_wave;

// T-wave (shifted later for realistic ST segment)
var T_wave = A_T * pow(E, -pow((X - mu_T), 2) / (2 * pow(sigma_T, 2)));

// Noise
var noise = 0.1 * (random() - 0.5); // Noise in range [-0.05, 0.05]

// Combine components
P_wave + QRS_wave + T_wave;
```