0.1 Low Pass Filter

The transfer function of the low pass filter is :

$$H(s) = \frac{1}{1 + sRC}$$

Discretizing using Tustin's approximation, $s \leftarrow \frac{2}{T_s}\frac{1-z^{-1}}{1+z^{-1}}$

$$H(z) = \frac{T_s(1 + z^{-1})}{T_s(1 + z^{-1}) + 2(1 - z^{-1})RC}$$

If $x(t)$ be the input to the filter and $y(t)$ be the output produced by the filter, the above filter in time domain is :

$$y(t) = \frac{1}{T_s + 2RC}\left[T_s\Big(x(t) + x(t-1)\Big) + (2RC - T_s)y(t-1)\right]$$

We can easily implement the above filter's form in code. Here T_s is the sampling period.

0.1.1 Implementation in MATLAB

```
% Transfer Function of RC circuit
% H = 1 / (1 + sRC)

function [out] = tust_lpf(in, time, fc)
% Apply Low Pass Filter using Tustin's Approximation

        out = zeros(size(in));
        out(1) = in(1);

        RC = 1 / (2*pi*fc);

        for i = 2:length(in)
                dt = time(i) - time(i-1);
                a = 1 / (dt + 2*RC);
                b = (2*RC - dt);
                out(i) = a * (dt * (in(i) + in(i-1)) ...
                        + b * out(i-1));
        end

end
```