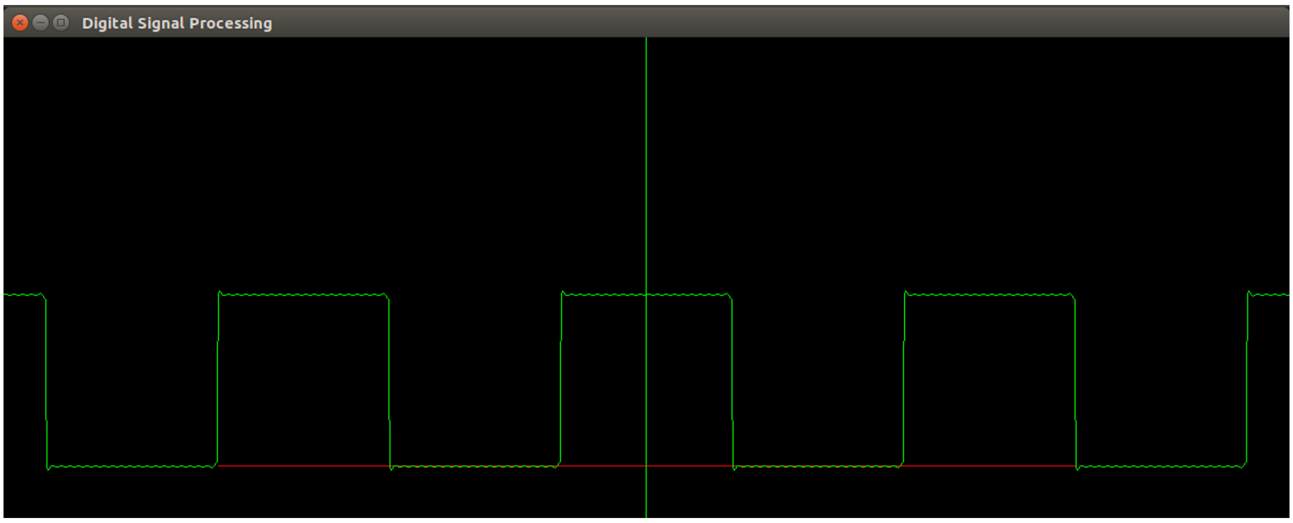
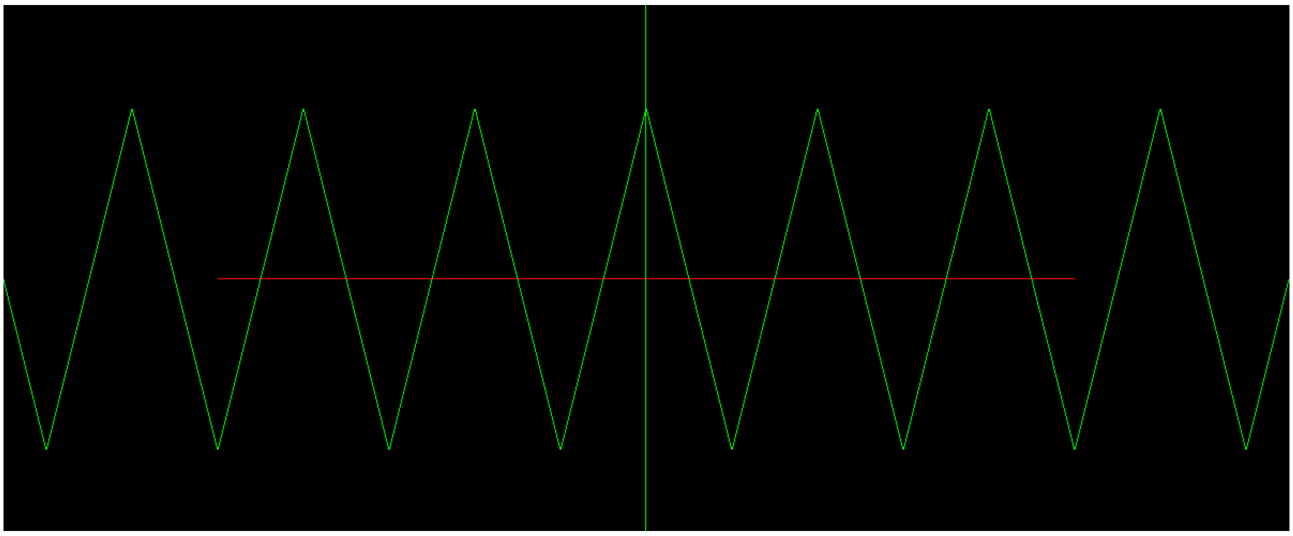
TI DSP, MCU, Xilinx Zynq FPGA 프로그래밍 전문가 과정

강사 – Innova Lee (이상훈)
gcccompil3r@gmail.com
학생 – 김형주
mihaelkel@naver.com

Install openGL

```
sudo apt-get update
sudo apt-get install build-essential
sudo apt-get install freeglut3 freeglut3-dev
sudo apt-get install glew-utils glee-dev
sudo apt-get install libglew-dev
```





```
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <math.h>

#include <GL/glut.h>

#define SLICE          360

void draw_omega_sin(void);

float common_angles[5] = {15.0, 30.0, 45.0, 60.0, 75.0};
float freq_table[5] = {1000.0, 2400.0, 5000.0, 24000.0, 77000.0};
float theta = 0.0;

void display(void)
{
	glClearColor(0.0, 0.0, 0.0, 1.0);
	glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
	glLoadIdentity();

	//gluLookAt(0.0, 0.0, 3.0, 0.0, 0.0, 0.0, 0.0, 1.0, 0.0);

	glColor3f(1, 0, 0);

	glBegin(GL_LINE_LOOP);
	glVertex3f(100.0, 0.0, 0.0);
	glVertex3f(-100.0, 0.0, 0.0);
	glEnd();

	glColor3f(0.0, 1.0, 0.0);

	glBegin(GL_LINE_LOOP);
	glVertex3f(0.0, 100.0, 0.0);
	glVertex3f(0.0, -100.0, 0.0);
	glEnd();

	draw_omega_sin();
	glutSwapBuffers();
}

#if 0
void reshape(int w, int h)
{
	glViewport(0, 0, (GLsizei)w, (GLsizei)h);
	glMatrixMode(GL_PROJECTION);
	glLoadIdentity();
	gluPerspective(60, (GLfloat)w / (GLfloat)h, 0.1, 100.0);
	glMatrixMode(GL_MODELVIEW);
}
#endif

void reshape(int w, int h)
{
	GLfloat n_range = 100.0f;

	if(h == 0)
		h = 1;

	glViewport(0, 0, w, h);
	glMatrixMode(GL_PROJECTION);
	glLoadIdentity();

	if(w <= h)
		glOrtho(-n_range, n_range, -n_range * h / w, n_range * h / w, -n_range, n_range);
	else
		glOrtho(-n_range * w / h, n_range * w / h, -n_range, n_range, -n_range, n_range);

	glMatrixMode(GL_MODELVIEW);
	glLoadIdentity();
}

void keyboard(unsigned char key, int x, int y)
{
	switch(key)
	{
		case 27:
			exit(0);
			break;
	}
}

void set_rand_amplitude(float *amp)
{
	*amp = rand() % 3 + 3;
}

void set_angle_with_common_angles(float *angle)
{
	*angle = common_angles[rand() % 5];
}

void angle2radian(float *angle, float *radian)
{
	*radian = *angle * M_PI / 180.0;
}

void radian2angle(float *angle, float *radian)
{
	*angle = *radian * 180.0 / M_PI;
}

void set_rand_frequency(float *freq)
{
	*freq = freq_table[rand() % 5];
}

void calc_period(float *freq, float *period)
{
	*period = 1 / (*freq);
}

void calc_angular_velocity(float *freq, float *ang_vel)
{
	*ang_vel = 2 * M_PI * (*freq);
}
```

```
float get_step(float slice, float period)
{
        return period / slice;
}

void cos_sim(float amplitude, float ang_vel, float period)
{
        int cnt = 0;
        float step, t = 0.0;

        t = step = get_step(SLICE, period);

        while(cnt++ < 36)
        {
                printf("%.1fcos(%f * %.8f) = %f\n", amplitude, ang_vel,
                                t, amplitude * cos(ang_vel * t));
                t += step;
        }
}

void sin_sim(float amplitude, float ang_vel, float period)
{
        int cnt = 0;
        float step, t = 0.0;

        t = step = get_step(SLICE, period);

        while(cnt++ < 36)
        {
                printf("%.1fsin(%f * %.8f) = %f\n", amplitude, ang_vel,
                                t, amplitude * sin(ang_vel * t));
                t += step;
        }
}

void draw_omega_sin(void)
{
        float amp, angle, period, freq, rad, omega, t, step = 0.0;
        float radius = 3.0;
        float x = 0, x2 = 0, y2, cx, cy;
        float tmp;
        int cache = 0;
        int n;
        srand(time(NULL));

#if 0
        set_rand_amplitude(&amp);
        set_angle_with_common_angles(&angle);
        angle2radian(&angle, &rad);
        set_rand_frequency(&freq);
        calc_period(&freq, &period);
        calc_angular_velocity(&freq, &omega);
```

```
#endif

#if 1
	amp = 10;
	angle = 45.0;
	freq = 0.5;

	angle2radian(&angle, &rad);
	calc_period(&freq, &period);
	calc_angular_velocity(&freq, &omega);
#endif

#if 0
	printf("amplitude = %f\n", amp);
	printf("angle = %f degree\n", angle);
	printf("radian = %f\n", rad);
	printf("frequency = %f\n", freq);
	printf("period = %f\n", period);
	printf("angular_velocity = %f\n", omega);
#endif

	t = step = get_step(SLICE, period);

	//printf("t = %f\n", t);
#if 1
	if(t > 3*period)
		t = 0.0;
#endif

	glBegin(GL_LINES);
	for(t = -300*period; ; t += step)
	{
		y2 = 0;
		if(t > 300 * period)
		{
			break;
			t = 0.0;
		}

		//float rad_angle = angle * (M_PI / 180.0);
		//x2 += x;			// time += step;
		//x2 += 0.1;
		//y2 = radius * sin((double)rad_angle);

		//y2 = amp * sin(omega * t);
		//y2 = t;
		for(n=1;n<400;n++)
			if(n%2)
				y2 += 8/(n*n*M_PI*M_PI)*cos(2*n*M_PI*t);
		y2 *= 40;
		if(cache)
		{
```

```
                glVertex2f(cx * 40, cy);
                glVertex2f(t * 40, y2);
            }

            cache = 1;
            cx = t;
            cy = y2;
            //printf("t = %f, y2 = %f\n", t * 4000, y2);
        }
        glEnd();
}

int main(int argc, char **argv)
{
        float amplitude, angle, period, frequency, radian, angular_velocity;
        float step = 0.0;

        glutInit(&argc, argv);
        glutInitDisplayMode(GLUT_DOUBLE);
        glutInitWindowSize(1200, 800);
        glutInitWindowPosition(0, 0);
        glutCreateWindow("Digital Signal Processing");

#if 0
        srand(time(NULL));

        set_rand_amplitude(&amplitude);
        set_angle_with_common_angles(&angle);
        angle2radian(&angle, &radian);
        set_rand_frequency(&frequency);
        calc_period(&frequency, &period);
        calc_angular_velocity(&frequency, &angular_velocity);

        printf("amplitude = %f\n", amplitude);
        printf("angle = %f degree\n", angle);
        printf("radian = %f\n", radian);
        printf("frequency = %f\n", frequency);
        printf("period = %f\n", period);
        printf("angular_velocity = %f\n", angular_velocity);

        cos_sim(amplitude, angular_velocity, period);
        sin_sim(amplitude, angular_velocity, period);
#endif

        glutDisplayFunc(display);
        //glutIdleFunc(display);
        glutReshapeFunc(reshape);
        //glutKeyboardFunc(keyboard);
        glutMainLoop();

        return 0;
}
```