M4 DSP Linear Interpolation

NuMicro® 32 位系列微控制器范例代码介绍

文件信息

代码简述	本范例代码使用M4内核DSP计算线性插值(Linear Interpolation)
BSP 版本	M480 Series BSP CMSIS V3.04.000
开发平台	NuMaker-PFM-M487 Ver 3.0

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1 功能介绍

1.1 简介

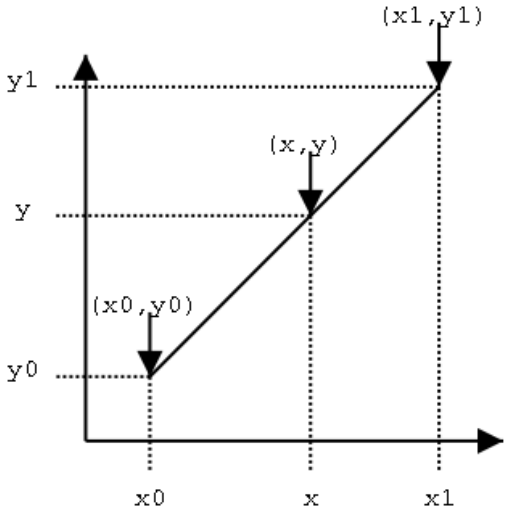
展示使用 CMSIS DSP 函式库进行线性内插运算(Interpolation)，用户可以直接使用这些函式，来实现自己的数学方程式运算。程序内比较了有无使用 DSP 计算时间的差异，并计算效率提升比率。

1.2 原理

假设目前已知坐标*(x0,y0)*和*(x1,y1)*要得到在线区间内某一位置x在直线上的值。根据下图所示，我们得到

$$\frac{y-y0}{x-x0}=\frac{y1-y0}{x1-x0}$$

由于x值已知，所以我们可以从公式得到y的值。



使用CMSIS DSP函式库线性插值功能首先宣告x0的样本数、起始值x0和x1值与值间隔，再来输入y值数据，程序设定如下表，完成浮点数插值结构设定之后，再输入x值执行程序，即可得到线性插值所得y值。

arm_linear_interp_instance_f32 S = {uint32_t nValues, float32_t x0, float32_t xSpacing, float32_t *pYData}		
参数：	nValues	x值的样本数
	x0	x起始值
	xSpacing	x值与值之间隔
	*pYData	y值数据
回传值：		无

arm_linear_interp_f32(arm_linear_interp_instance_f32 *S, float32_t x)		
参数：	*S	[in, out]浮点数插值结构
	x	[in] 输入x值
回传值：		线性插值y结果

1.3 执行结果

执行后会打印出以下信息

```
+----------------------------------------+
|      DSP Interpolation Sample Code     |
+----------------------------------------+

Calculating time with DSP instruction is 0.004250 ms

Calculating time without DSP instruction is 0.004833 ms

Efficiency increase rate is 1.14
```

2 代码介绍

使用CMSIS DSP函数库进行线性内插运算(Linear Interpolation)运算：

```
    /* Calculate Liner interpolation with DSP, Calculation results will return to
testLinIntOutput */
    for(i=0; i<TEST_LENGTH_SAMPLES; i++) {
        testLinIntOutput[i] = arm_linear_interp_f32(&S, testInputSin_f32[i]);
    } ;
```

接着使用CPU进行相同的计算：

```
/* Calculate Interpolation */
float interp(int n,float x1,float xSpacing,float x)
{
    float y, y0, y1, x0;                    /* Nearest output values */
    int32_t i;                              /* Index variable */

    /* Calculation of index */
    i = (x - x1) / xSpacing;
    if(i < 0) {
      /* Iniatilize output for below specified range as least output value of table */
      y = arm_linear_interep_table[0];
    }
    else if(i >= n) {
      /* Iniatilize output for above specified range as last output value of table */
      y = arm_linear_interep_table[n - 1];
    }
    else {
      /* Calculation of nearest input values */
      x0 = x1 + i * xSpacing;
      x1 = x1 + (i + 1) * xSpacing;
      /* Read of nearest output values */
      y0 = arm_linear_interep_table[i];
      y1 = arm_linear_interep_table[i + 1];
      /* Calculation of output */
      y = y0 + (x - x0) * ((y1 - y0) / (x1 - x0));
    }
    /* returns output value */
    return (y);
}
```

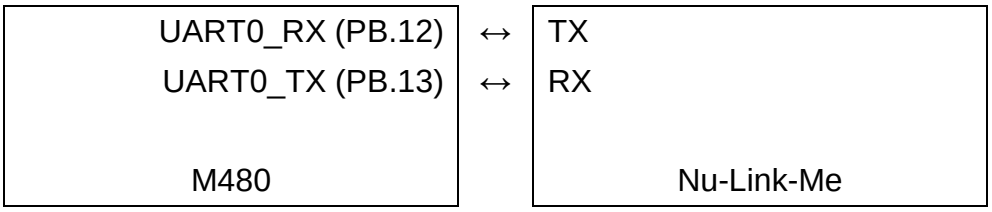
把计数器换成时间，其中计数器时钟源为HXT 12MHz：

```
    /* Calculate the time, timer clock source is 12M, unit is ms */
    DSPCalTime = (DSPCalTime/12000000) * 1000;
    CalTime = (CalTime/12000000)* 1000;
```

3 软件与硬件环境

- 软件环境
  - BSP 版本
    - M480 Series BSP CMSIS V3.04.000
  - IDE 版本
    - Keil uVersion 5.26
- 硬件环境
  - 电路组件
    - NuMaker-PFM-M487 or other M480 Development Board
  - 示意图

M480 的 UART0_RX(PB.12)、UART0_TX(PB.13)连接至 Nu-Link Me，打印讯息。
设置终端机的 COM Port 与 Baud，COM Port 的编号可在设备管理器中找到「NuBridge Virtual Com Port (COMX)」，Baud 设置为 115200。



4 目录信息

- EC_M480_Interpolation_V1.00
  - Library — Sample code header and source files
    - CMSIS — Cortex® Microcontroller Software Interface Standard (CMSIS) by Arm® Corp.
    - Device — CMSIS compliant device header file
    - StdDriver — All peripheral driver header and source files
  - SampleCode
    - ExampleCode — Source file of example code

5 如何执行范例程序

1. 根据目录信息章节进入 ExampleCode 路径中的 KEIL 文件夹，双击 DSP_Interpolation.uvproj
2. 进入编译模式接口
   a. 编译
   b. 下载代码至内存
   c. 进入 / 离开除错模式
3. 进入除错模式接口
   a. 执行代码

6 修订纪录

Date	Revision	Description
Jun. 25, 2019	1.00	1. 初始发布.

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