

## M4 DSP Fast math function

NuMicro<sup>®</sup> 32 位系列微控制器範例代碼介紹

### 文件資訊

代碼簡述	本範例代碼使用M4內核DSP計算正弦和餘弦
BSP 版本	M480 Series BSP CMSIS V3.04.000
開發平台	NuMaker-PFM-M487 Ver 3.0

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# 1 功能介紹

## 1.1 簡介

展示使用 CMSIS DSP 函式庫快速數學運算，其中為三角函數運算包含

1. 正弦(輸入為弧度)
2. 餘弦(輸入為弧度)
3. 正弦和餘弦(輸入為角度)

用戶可以直接使用這些函式，來實現自己的數學方程式運算。

程式內比較了有無使用DSP計算時間的差異，並計算效率提升比率。

## 1.2 原理

CMSIS M4 DSP函式庫，提供了計算正弦，餘弦的功能，以查表的方式減少計算時間：

arm_cos_f32(float32_t x)		
參數：	x	[in]欲計算的弧度
回傳值：	cos(x)	

arm_sin_f32(float32_t x)		
參數：	x	[in]欲計算的弧度
回傳值：	sin(x)	

arm_sin_cos_f32(float32_t theta, float32_t *pSinVal, float32_t *pCosVal)		
參數：	theta	[in] 欲計算的角度
	*pSinVal	[out] sine值輸出
	*pCosVal	[out] cosine值輸出
回傳值：	無	

### 1.3 執行結果

執行後會打印出以下資訊

```
+-----+
| DSP Fast math functions Sample Code |
+-----+

Calculating time with DSP instruction is 0.045583 ms
Calculating time without DSP instruction is 2.823167 ms
Efficiency increase rate is 61.93
```

## 2 代碼介紹

使用CMSIS DSP函數庫進行正弦餘弦運算：

```
/* Use DSP instruction to calculate sine and cosine with 32 sample */
for(i=0; i< blockSize; i++) {
    /* input is radian */
    cosOutput[i] = arm_cos_f32(testInput_f32[i]);
    sinOutput[i] = arm_sin_f32(testInput_f32[i]);

    /* input is degree */
    arm_sin_cos_f32(testInput_f32[i], &sinOutput1[i], &cosOutput1[i]);
}
```

接著使用CPU進行相同的計算：

```
/* Calculate sine and cosine with 32 sample */
for(i=0; i< blockSize; i++) {
    /* input is radian */
    cosine[i] = cos(testInput_f32[i]);
    sine[i] = sin(testInput_f32[i]);
    /* input is radian */
    sin_cos(testInput_f32[i]);
}
```

把計數器換成時間，其中計數器時鐘源為HXT 12MHz：

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

### 3 軟體與硬體環境

#### ● 軟體環境

- BSP 版本
  - ◆ M480 Series BSP CMSIS V3.04.000
- IDE 版本
  - ◆ Keil uVersion 5.26

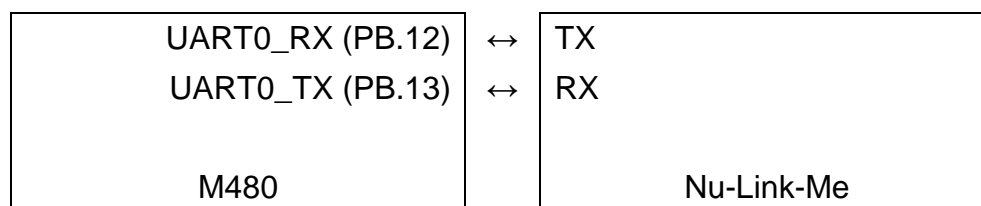
#### ● 硬體環境

- 電路元件
  - ◆ NuMaker-PFM-M487 or other M480 Development Board
- 示意圖

M480 的 UART0\_RX(PB.12)、UART0\_TX(PB.13)連接至 Nu-Link Me，打印訊息。







設置終端機的 COM Port 與 Baud，COM Port 的編號可在裝置管理員中找到「NuBridge

Virtual Com Port (COMX)」，Baud 設置為 115200。



## 4 目錄資訊

### EC\_M480\_DSP\_FastMath\_V1.00

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

## 5 如何執行範例程式

1. 根據目錄資訊章節進入 ExampleCode 路徑中的 KEIL 資料夾，雙擊 DSP\_FastMath.uvproj
2. 進入編譯模式介面
  - a. 編譯
  - b. 下載代碼至記憶體
  - c. 進入 / 離開除錯模式
3. 進入除錯模式介面
  - a. 執行代碼

## 6 修訂紀錄

Date	Revision	Description
Jun. 25, 2019	1.00	1. 初始發布.



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