

M4 DSP Fast math function

Example Code Introduction for 32-bit NuMicro® Family

Information

Application	This sample code uses the M4 DSP to calculate sine and cosine
BSP Version	M480 Series BSP CMSIS V3.04.000
Hardware	NuMaker-PFM-M487 Ver 3.0

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1 Function Description

1.1 Introduction

This sample code uses the CMSIS DSP library to calculate Fast math functions, including

1. Sine (input value in radians)
2. Cosine (input value in radians)
3. Sine and Cosine (input value in degrees)

User can use these functions to implement mathematical equations. The sample code compares the difference between using the DSP calculation time and calculates the efficiency improvement ratio.

1.2 Principle

The CMSIS DSP library provides calculation of sine and cosine to reduce computation time by lookup table method. Its definition is as shown in table :

arm_cos_f32(float32_t x)		
Parameters :	x	[in] x input value in radians.
Returns :	cos(x)	

arm_sin_f32(float32_t x)		
Parameters :	x	[in] x input value in radians.
Returns :	sin(x)	

arm_sin_cos_f32(float32_t theta, float32_t *pSinVal, float32_t *pCosVal)		
Parameters :	theta	[in] input value in degrees
	*pSinVal	[out] points to processed sine output
	*pCosVal	[out] points to processed cosine output
Returns :	none	

1.3 Demo Result

```
+-----+
| 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 Code Description

Use CMSIS DSP library to calculate sine and cosine :

```
/* 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]);
}
```

And calculation sine and cosine without DSP :

```
/* 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]);
}
```

Change the counter to time, where the timer clock source is HXT 12MHz :

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

3 Software and Hardware Environment

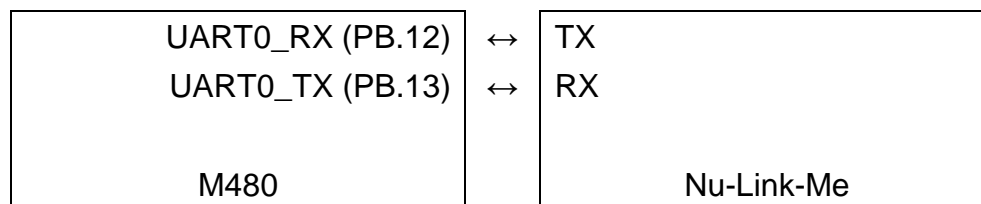
- **Software environment**

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

- **Hardware environment**







- Circuit components
 - ◆ NuMaker-PFM-M487 or other M480 Development Board
- Diagram

M480's UART0_RX (PB.12) and UART0_TX (PB.13) are connected to Nu-Link Me to print the message. Set COM port and Baud. The number of the COM Port can be found in the device manager "NuBridge Virtual Com Port (COMX)" and Baud is set to 115200.



4 Directory Information

 EC_M480_DSP_FastMath_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 How to Execute Example Code

1. Browsing into sample code folder by Directory Information (section 4) and double click DSP_FastMath.uvproj
2. Enter Keil compile mode
 - a. Build
 - b. Download
 - c. Start/Stop debug session
3. Enter debug mode
 - a. Run

6 Revision History

Date	Revision	Description
Jun. 25, 2019	1.00	1. Initially issued.

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