RC0 - VFP programming

This course explains how to use VFP instructions to boost multimedia algorithms

Objectives

- This course has been designed for programmers wanting to develop algorithm based on hardware floating point calculations.
- Each instruction family is detailed, first at assembly level, and then at C level using macros.
- Several tricky usage of vector instructions are provided.
- The underlying cache operation as well as preload mechanisms (instruction and hardware prefetch) are detailed to explain how a processing can be pipelined .
- The course shows how DSP typical algorithms such as FIR and FFT can be vectorized and then optimized to be executed on VFP unit.
- THIS COURSE IS PROPOSED EITHER AS AN INSTRUCTOR-LED COURSE OR AS E-LEARNING.
- ACSYS has developed an optimized VFP based FFT coded in assembler language
  - performance for 1024 complex floating point single precision samples is 220_000 core clock cycles (ARM11)
  - for any information contact formation@ac6-formation.com

Labs are run under RVDS

A more detailed course description is available on request at formation@ac6-formation.com

Prerequisites

- Knowledge of 4T / V5TE instruction set.

Course Environment

- Theoretical course
  - PDF course material (in English) supplemented by a printed version for face-to-face courses.
  - Online courses are dispensed using the Teams video-conferencing system.
  - The trainer answers trainees' questions during the training and provide technical and pedagogical assistance.
- At the start of each session the trainer will interact with the trainees to ensure the course fits their expectations and correct if needed

Target Audience

- Any embedded systems engineer or technician with the above prerequisites.

Course Outline

IEEE754 STANDARD

- Floating point number coding
- Denormalized numbers
- NaN utilization
- Rounding modess
- VFP FPEXC register

INTRODUCTION TO VFPv3

- Register bank, D registers, S registers
- Instruction coding, either ARM or Thumb-2
- Related system registers
- Alignment issues
- Context switching

VECTOR vs SCALAR OPERATION

- Length / Stride combinations
- Scalar operations
- Vector operations
- Mixed operations

VFP LOAD / STORE INSTRUCTIONS

- Addressing modes
- Floating point load / store
- Floating point load / store multiple
- Processor acceleration mechanisms: store merging buffers

ARITHMERICAL INSTRUCTIONS

- Add / subtract / absolute value instructions
- Multiply and multiply accumulate instructions
- Divide instruction
- Square root instruction
- Compare instructions
- Integer to FP and FP to convert instructions

VFP CODING EXAMPLES

- FIR filter
  - Converting the scalar algorithm into a vector algorithm
  - Finding the VFP instructions to encode the vector algorithm
  - Optimizing the code
- FFT (DFT)
  - Converting the scalar algorithm into a vector algorithm, understanding how circle properties can be used to process 4 angles concurrently
  - Finding the VFP instructions to encode the vector algorithm
  - Optimizing the code