



## 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 [training@ac6-training.com](mailto:training@ac6-training.com)

*Labs are run under RVDS*

*A more detailed course description is available on request at [training@ac6-training.com](mailto:training@ac6-training.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.

### Evaluation modalities

- The prerequisites indicated above are assessed before the training by the technical supervision of the trainee in his company, or by the trainee himself in the exceptional case of an individual trainee.
- Trainee progress is assessed by quizzes offered at the end of various sections to verify that the trainees have assimilated the points presented
- At the end of the training, each trainee receives a certificate attesting that they have successfully completed the course.
  - In the event of a problem, discovered during the course, due to a lack of prerequisites by the trainee a different or additional training is offered to them, generally to reinforce their prerequisites, in agreement with their company manager if applicable.

## Plan

### IEEE754 STANDARD

- Floating point number coding
- Denormalized numbers
- NaN utilization
- Rounding modes
- 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

### ARITHMETICAL INSTRUCTIONS

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

## Renseignements pratiques

**Inquiry : 1 day**