Course Description

Course name	**#016 - Versatile Video Coding: Algorithms and Specification**
Duration	**2 days**
Format	**Public Classroom, Inhouse Event and Online**

Overview

Dr. Mathias Wien, RWTH Aachen University, Germany, is teaching about **Versatile Video Coding.**

Video delivery accounts for about 2/3 of today's internet traffic and is expected to grow further. At the same time, the target application space evolves further towards higher picture resolution, higher dynamic range (HDR), fast motion capture, or previously unaddressed formats such as 360° video.

While HEVC is the state-of-the-art video compression standard with profiles addressing virtually all video-related products of today, the next generation standard Versatile Video Coding (VVC) is currently taking shape. The VVC working draft shows significant performance improvements relative to the established technology.

This course is intended for engineers with a background in signal processing. Participants new to the field will be introduced to video coding. Participants with video coding experience will be updated to the significant developments in most recent video coding standardization.

Technical Focus

The required compression efficiency of modern video coding standards is achieved with elaborate signal processing and highly optimized entropy coding algorithms. The course focusses on this technology. Departing from the fundamentals of block-wise picture prediction and transform coding of the residual, all relevant video coding technology aspects are presented and discussed.

Course Content

This 2-day course consists of three major blocks:
- The first block covers video coding fundamentals, including the video processing chain, video signals, the representation of color, and the basic video coding loop.
- The second block concentrates on design requirements and standardization aspects. Here, specification principles as well as normative and non-normative aspects of the design are addressed.
- The third block provides a complete tour through the video coding loop, including coding structures, inter and intra prediction, residual coding, loop filtering, and entropy coding. It covers the application range of SDR, HDR, and 360° video. The tools in the VVC working draft are presented and compared to those of HEVC.

The course blocks are supplemented with video demos wherever possible. The design of coding tools is discussed in view of often opposing requirements regarding computational complexity and compression performance. Visual examples demonstrate the impact of compression artifacts on the observed visual quality of the reconstructed video signal.

Who should attend?
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Course Daily Schedule

Day 1

- **Block I: Video Coding Fundamentals**
    - Introduction
    - Video Signals and Video Signal Processing
    - Standardization History
- **Block II: Design and Specification**
    - Specification Principles and Elements
    - Specification Drafting
    - Profiles, Levels, Tiers
- **Block III: VVC Video Coding Loop**
    - Spatial and Temporal Coding Structures
    - High-Level Syntax

Day 2

- **Block III: VVC Video Coding Loop (continued)**
    - Intra Prediction
    - Inter Prediction
    - Residual Coding
    - Loop Filters
    - Entropy Coding
    - Tools for HDR Video
    - Tools for 360° Video
- **Summary**
    - Current Standardization Status
    - Outlook

Instructor Biography

Dr. Mathias Wien received the Diploma and Dr.-Ing. degrees from Rheinisch-Westfälische Technische Hochschule Aachen (RWTH Aachen University), Aachen, Germany, in 1997 and 2004, respectively.

In 2018, he achieved the status of the habilitation, which makes him an independent scientist in the field of visual media communication. He was with Institut für Nachrichtentechnik, RWTH Aachen University (head: Prof. Jens-Rainer Ohm) as a researcher from 1997-2006, and as senior researcher and head of administration from 2006-2018.

Since July 2018, he has been with Lehrstuhl für Bildverarbeitung, RWTH Aachen University (head: Prof. Dorit Merhof) as senior researcher, leader of the Visual Media Communication group, and head of administration.

His research interests include image and video processing, immersive, space-frequency adaptive and scalable video compression, and robust video transmission. Mathias has been an active contributor to VVC, HEVC, and H.264/AVC. He has participated and contributed to ITU-T VCEG, ISO/IEC MPEG, the Joint Video Team (JVT), the Joint Collaborative Team on Video Coding (JCT-VC), and the Joint Video Experts Team (JVET) of VCEG and ISO/IEC MPEG.

He has served as a co-editor of the scalability amendment to H.264/AVC (SVC). In the standardization bodies, he has co-chaired and coordinated several AdHoc groups as well as tool- and core experiments. Mathias has published more than 60 scientific articles and conference papers in the area of video coding and has co-authored several patents in this area. Mathias has further authored and co-authored more than 200 standardization documents. He has published the Springer textbook “High Efficiency Video Coding: Coding Tools and Specification”, which fully covers Version 1 of HEVC.

Dr. Wien has been a member of the Continuing Education Institute-Europe Faculty since 2019.