

Strong Demand For Analog IC Design Online Learning

The 2020 pandemic was the catalyst for the “Analog IC Design” short-courses arranged by Hooman Reyhani (IEEE United Kingdom and Ireland Section) since 2015, to switch from the conventional in-person format at the University of Limerick, Ireland, to a live-virtual platform. These online courses are carefully designed to deliver maximum learning for global participants, from world-class experts, offering many unique features including distributed lectures (held twice-weekly over four weeks), live Q&A, optional homework assignments, lecture playback, course forum, etc.

The phenomenal demand for these state-of-the-art online learning programmes resulted in two sell-out courses being held in 2021 and three more in 2022. The opening course of 2023 marked an important milestone of 1000+ global participants, representing semiconductor tech-giants and leading research organizations, from 6 continents, 35+ countries and 19 time-zones, taking part in these cutting-edge analog IC design courses, held since 2015.

The “Modern Wireline Transceivers” live-virtual short-course, held in January 2023, welcomed 100 participants, from 5 continents, 21 countries and 17 time-zones, eagerly tuning in to the captivating presentations of Prof. Chan Carusone (University of Toronto & Alphawave Semi). This course explored the critical system-level aspects of tomorrow’s 200 Gbps transceiver challenges where the participants learned all the main building blocks of a wireline transceiver system and the interaction between them, as well as the requirements of various sub-systems, depending on the application. DSP modelling as well as jitter modelling were covered in depth.

The slide, titled "Equalization & Baud-Rate Timing Recovery Interaction", illustrates the interaction between equalization and timing recovery in a digital communication system. It features a block diagram of a receiver chain: FEC Enc. → FIR → AFE → FFE-t → FFE → DFE → FEC Dec. The AFE block is highlighted in red and contains a feedback loop with an MM-PD (Manchester Modulation Phase Detector) and a PLL (Phase-Locked Loop) for timing recovery. The MM-PD gain is given as $\frac{dh_1}{d\phi} - \frac{dh_{-1}}{d\phi}$. Two graphs are included: the top one shows the channel impulse response $h(t)$ with samples h_{-1} , h_0 , and h_1 marked; the bottom one shows the pulse response of the receiver chain. A small video inset shows Prof. Tony Chan Carusone.

Equalization & Baud-Rate Timing Recovery Interaction

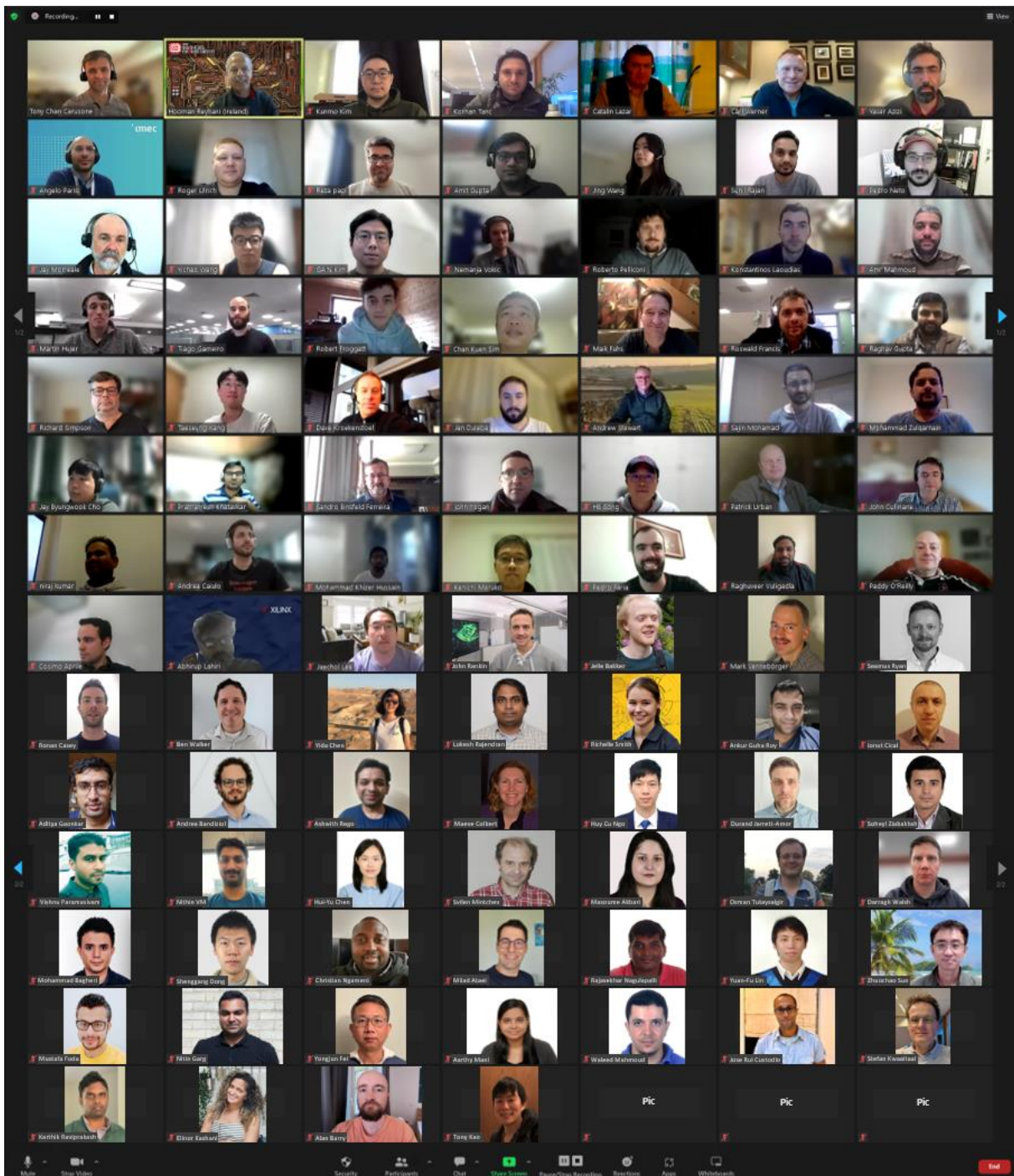
- MM-PD detects phase error based on the correlation of neighbouring equalized samples
- It performs best when:
 - $-dh_{\pm 1}/dt$ is large
 - $-h_k \approx 0, |k| > 1$

MM-PD gain: $\frac{dh_1}{d\phi} - \frac{dh_{-1}}{d\phi}$

Thus, slightly different criteria apply to the optimization of FFE-t and the main FFE/DFE which seek to minimize all $h_k, k \neq 0$.

- Note, the AFE is implicated in both paths

Prof. Tony Chan Carusone, course presenter, talked about Modern Wireline Transceiver systems at an online course hosted by Hooman Reyhani, Ireland.



The lecturer, organizer and many of the participants of the *"Modern Wireline Transceivers"* online course, January 2023.

The main topics included Trends and Applications of SerDes; Modulation and Coding; Channel Modelling; Analog & Digital Equalization; Maximum Likelihood Sequence Detection; Clocking; Optical Communication; and Case Studies. Exciting Python-based homework assignments (optional) included the generation of 2-PAM & 4-PAM waveforms with filtering, coding & decoding with bursts of errors, channel modelling with non-idealities, CTLE circuit modelling, partial response trellises, Rx & Tx clock jitter modelling, optical modulation & RLM.

Prof. Chan Carusone has been a faculty member at the University of Toronto since 2002. He is currently the Chief Technology Officer of Alphawave Semi in Toronto, Canada. He has co-authored the classic textbooks “Analog Integrated Circuit Design” and “Microelectronic Circuits”, as well as several award-winning publications at various IEEE conferences. Dr. Chan Carusone was a Distinguished Lecturer for the IEEE SSCS, 2015-2017, and served on the TPC of the ISSCC, 2015-2021. He has served as Editor-in-Chief of the IEEE TCAS II, Associate Editor for the IEEE JSSC, and is now Editor-in-Chief of the IEEE SSCL. He is a Fellow of the IEEE.

The feedback from the course participants was extremely gratifying. One participant wrote, *“Prof. Chan Carusone has a deep knowledge of this topic with confident command of the presentation”*. Another said, *“The course exceeded my expectations. I learnt a lot in a relatively short time”*. While another commented, *“The infrastructure, organisation, and especially the recordings are a major plus. The course format is perfect and optimized for a global audience”*.

For more information about these courses, please visit <https://hoomanreyhani.com/>.

— Hooman Reyhani