

MINUTE OF ATRC MEETING HELD ON 6/27/90 AT SARNOFF CENTER, PRINCETON.

Present at meeting:

Sarnoff: K. Joseph (KJ), S. Ng (SN), D. Raychaudhuri (DR), G. Reitmeier (GR), J. Shapiro (JS), C. Wine (CW), J. Zdepski (JZ).
Present only in the afternoon: C. Carlson (CC), J. Gibson (JG), and H. White (HW).

NAP: F. Azadegan (FZ), C. Basile (CB), D. Bryan (DB), C. Greebe (CG), Y. Ho (YH), D. Teichner (DT), M. Tsinberg (MT).

Key Issues Discussed during the 6/27/90 ATRC Meeting

Video Coding Effort:

Seven separate video algorithm development efforts were listed. These correspond to the efforts identified in the previous ATRC meeting (6/21/90) held at Briarcliff. The efforts are:

Block-Match DCT (LEP), Block-Match DCT (DTB), Flow field QMF (CW/RH/JS), 3D VQ (JZ), VQ/Subband (YH), Adaptive SBC (SN), Predictive SBC (FA)

The seven video coding sub-projects would proceed in parallel of each other for the next six months, aiming for a testing and evaluation phase by the end of 1990.

Informal, frequent contacts among the people in these parallel efforts is highly encouraged; cross-fertilization is desired.

There was a concern that effort toward merging of sub-projects among the seven development work may be premature and can potentially hamper any unforeseen crossing of ideas.

A new effort to define Testing and Evaluation (T&E), in the charge of Ng and Teichner, was identified. The T&E effort will begin to formulate a plan for testing and evaluating different algorithms or systems from the video coding efforts.

Formation of four study group (SG):

Coding SG: FA, YH, AC(Allan), JZ, SN, RH(Raj), and CW

Modem/r.f. SG: CB, DB, AGC (Aldo Cugini), HW, KJ (Krish), JGNH (Henderson), and DR

T&E SG: DT, and SN

System SG: FA, CB, DR, SN

Remaining Issues:

The issue of source format was raised. The need for the testing and evaluation of different systems on the same picture format was emphasized. There was a concern that a single, fixed format may perforce limit the performance of a system. For the time being, the coding effort must proceed with whatever source materials that are available.

Software exchange was also discussed. Some possible exchange protocols were suggested:

1. All exchange softwares must conform to some interface standard so that the exchange is straightforward. This may be done by having some person(s) to do all the necessary changes in the software modules.
2. The author of the software makes the necessary changes in his own software so that it can be used by the foreign program.
3. The burden of making the necessary changes in the software falls on the receiving person(s). The author of the software is consulted on occasions.

There was no firm commitment to any particular protocol. One widespread feeling is that a hybrid of protocols 2 and 3 is the common practice.

It was agreed that an ATRC general meeting should be held once every two months, while the different study groups would meet more frequently, for e.g., once every two weeks. The system SG, however, would not be active until the later phase of the program when various systems/algorithms come together.

Video Demo:

A series of video demos were presented. Joel showed simulation of the Keil Harbor sequence processed by a simplified version of his 3D VQ system. A simple AWGN (additive white Gaussian noise) channel model was included, and the robust nature of Joel's 3D VQ was demonstrated. The range of CNR for the channel model is 20–30 dB.

Jerry and Charlie showed several simulations of the flow field algorithm.

Sheau showed a simulation of an 8x8 sub-band coder with a block-match motion compensation preprocessor.

Two separate meetings were held in the afternoon: the video coding meeting and the modem/r.f. meeting.

Video Coding Meeting

Present were:

Sarnoff — KJ, SN, JS, and JZ.

NAP — FA, YH, and DT.

A list of existing software modules as well as each individual's experience in various coding algorithms was generated. (See attachment.) The meeting started with a round-table discussion of source material availability. The video simulation facilities at NAP are undergoing some major changes for the next two months. By the end of August, the new DVS at NAP is expected to be in full operation. For the time being, limited display capability (non-HDTV) exists and will continue to be used for the video coding research at NAP. The transfer of picture files between Sarnoff and NAP was discussed. NAP has difficulty connecting to foreign machines using "ftp". Communication via e-mail should and would be established. Large file transfer, however, would be difficult, if not impossible, over e-mail network. Tape transfer was suggested as an alternative.

Each person then gave a brief description of what his current work is, and his plan for the next two weeks. It was stated that NAP's work has been focussed on intra-frame (spatial) processing and the inter-frame processing work is only beginning to be expanded.

Faramarz described his SBC system: 4x4 spatial sub-band, using QMF (Johnston's 16-tapped FIR filters); vector-DPCM on the low-low band, PCM on the rest of the sub-bands.

Sheau described his motion-compensated SBC. He will begin to incorporate refresh and to continue the work on quantizing the sub-bands adaptively. Currently all the diagonal sub-bands are zeroed out.

Jerry talked about the flow field system, with DCT on the flow field data. There was some discussion on the use of uniform quantizer versus non-uniform quantizer. It was agreed that with entropy coding, a uniform quantizer is preferred to a Lyod-Max quantizer, but that a non-uniform quantizer that is not necessarily Lyod-Max (i.e., minimum MSE quantizer) can be better even with entropy coding.

Yo-Sung described a QMF sub-band system with VQ applied to the different bands. The sub-bands are logarithmically spaced. Each band has its own vector code book. The low-low band is a video band with non-zero mean. Yo-Sung will explore multi-stage VQ (i.e., successive VQ on the residual of a previous VQ stage.)

Joel talked about his 3D VQ system, with 8 classes of possible vector configuration. He will continue to work on the module. Currently the system only exists in a simplified form. His future

plan includes a scalar quantization of the VQ residual (instead of the multi-stage VQ suggested by Yo-Sung.)

Because NAP has only begun to look into temporal processing, whereas Sarnoff has built up a substantial library of modules for temporal and spatial processing, some transfer of software from Sarnoff to NAP may be in order.

It was agreed that a biweekly meeting for the entire video study group would be more beneficial to all instead of small meetings between individuals working on parallel efforts. This is because there is substantial overlap in the various parallel efforts on video coding. Communication among individuals is probably more effective on a need basis.

July 11 was marked as the next meeting date. The meeting will be held at the NAP facilities in Briarcliff Manor. A tentative agenda for the meeting is the following.

- Project plan for each algorithm effort, with emphasis on showing how the effort would be pursued to meet the T&E deadline of 1/1/91.
- Detailed information on the European (LEP and DTB) counterparts approaches (block-match motion-compensated DCT.)
- NAP video demo.
- Jerry and Kuria to discuss the reference model (RM1) frame work.
- Progress report on various algorithms.

Modem/R.F. Meeting

Present were:

Sarnoff — DR, GR, CW, CC, JG, and HW.

NAP — CB, DB, CG and MT.

The afternoon ATRC meeting on modem/RF issues is summarized below:

The meeting started with J. Gibson's presentation on ATV coverage & interference issues. The matter of developing a detailed spectrum allocation model for the U.S. was discussed. J. Gibson estimated that the cost of developing such a model would be of the order of several million \$, suggesting that industry-wide funding be considered (possibly in co-operation with competitors such as Zenith). M. Tsinberg suggested that further action in this area be carried by J. Gibson with support from an NAP staff member to be nominated by him (Aldo Cugini??).

NAP presented a summary of the contract research on CPM being done for them by RPI. There was some discussion about the applicability of CPM (which tends to achieve ~2-3 bps/Hz) for

terrestrial broadcast. NAP will look into the performance of CPM in the target 5-6 bps/Hz regime. It was suggested that some of the simulation tools developed in connection with the CPM program may be useful for digital simulcast. NAP will look into re-directing RPI to provide a simulation model for trellis-coded QAM. RPI representatives may be invited to attend future meetings of the modem/RF subgroup (the next meeting is tentatively scheduled for 11 July).

Hugh White presented an overview of modem hardware development at Sarnoff. A working prototype of a ~20 Mbps 16-QAM modem (also ~10 Mbps QPSK) has been constructed and tested to demonstrate performance close to theory. There was some discussion on design issues including carrier synchronization (not yet implemented) and bit-timing recovery (implemented). Forward error correction (FEC) has not been considered so far.

NAP has a Comdisco software for simulating communication systems. Hugh will work with Dave on how the Sarnoff modem development work can take advantage of that tool.

Preliminary objectives for the modem/RF group were identified as: (a) development of a higher speed ~30 Mbps modem; (b) development of techniques for NTSC "friendly" and "robust" properties; (c) consideration of joint source/channel coding issues; and (d) RF coverage/interference assessments. It was agreed that a detailed project plan for modem/RF work will be completed by 9/1/90.

It was agreed that system subgroup activities will be phased in gradually, probably beginning on 9/1/90 after some progress has been made in the video compression and modem/RF areas.