

Review of "Vector Quantization" by Huseyin Abut

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This book is a collection of 66 important journal and conference papers published since 1979 relating to vector quantization (VQ), a popular technique for lossy data compression. The text is divided into six parts: (1) Tutorials on VQ, (2) Theoretical Studies and Algorithms, (3) Speech Coding, (4) Image Coding, (5) Segmentation, Classification, and Recognition, and (6) Real-Time Implementation. This collection covers both the theory and implementation of a broad spectrum of applications of VQ. It is geared towards the person in academia or industry as a reference to many of the classic papers that have advanced this field over the last decade or so.

In Part 1, four tutorial papers introduce the beginner to VQ as a compression tool and to some of its basic applications in speech

and image coding. Each of these papers is very well written and relatively easy to read.

Part 2 presents some of the more general papers that have laid the foundation of VQ theory. These include papers about iterative design algorithms such as the well-known generalized Lloyd (or LBG) algorithm, asymptotic optimality (high resolution theory), fast encoding algorithms, entropy constrained quantization, and some structured quantization schemes.

Part 3 reflects the surge of recent interest in using VQ as a fundamental building block in low complexity, structured systems for compressing human voice to below 16 kbits/sec. The main idea behind many of the schemes is to use linear predictive cod-

ing (LPC) to extract the redundancy from speech signals and subsequently use VQ to approximate a residual signal. Other techniques include subband coding and Codebook Excited Linear Prediction (CELP). These techniques attempt to improve the quality of speech for the human auditory system while at the same time exploiting knowledge of the human vocal system.

Part 4 deals with vector quantization of image and video signals. Topics addressed here include classified VQ, predictive VQ, incorporating a model of the human visual system into VQ systems, and combining VQ with the Discrete Cosine Transform (DCT). How research in image and video VQ will affect future image compression standard development such as p*64, JPEG, and MPEG remains to be seen.

Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT	DUE DATE
Nov. 29-Dec. 2 1992	IEEE Second International Symposium on Spread Spectrum Techniques and Applications (ISSSTA'92)	Yokohama Japan	Prof. Masao Nakagawa Dept. of Electrical Engineering Keio University 3-14-1, Hiyoshi, Kouhoku-ku, Yokohama, 223 Japan Tel: +81-45-563-1141 Ext. 3329 Fax: +81-45-563-3421 E-mail: Nakagawa@nkgw.elec.keio.ac.jp	5/1/92
Dec. 6-9 1992	1992 IEEE Global Telecommunications Conference (GLOBECOM'92)	Orlando Florida	Ronald Kandell Siemens/Stromberg-Carlson 900 Broken Sound Parkway Boca Raton, FL 33487 Tel: 407-955-8230; Fax: 407-955-8771	
Dec. 7-8 1992	Communication Theory Mini-Conference	Orlando Florida	Prof. Paul Kakaes The George Washington University Dept. of Elect. Engr. and Computer Science Washington, DC 20052 Tel: 202-994-6919; Fax: 202-994-0227 E-mail: kakaes@seas.gwu.edu	
Dec. 16-18 1992	31st IEEE Conference on Decision and Control	Tucson Arizona	Prof. T. Basar Coordinated Science Lab. University of Illinois 1101 West Springfield Ave. Urbana, IL 61801 Tel: 217-333-3607; Fax: 217-244-1653 E-mail: tbasar@markov.csl.uiuc.edu	3/1/92
Jan. 18-22 1993	1993 IEEE International Symposium on Information Theory	San Antonio Texas	Prof. Costas Georghiades Dept. of Electrical Engr. Texas A&M University College Station, TX 77843. Tel: (409) 845-7408 E-mail: georghiad@ee.tamu.edu	

Part 5 covers the use of VQ for the field of speech recognition. VQ can be used either as a front end for a recognition system (to reduce the data to a manageable quantity of essential information) or as an inherent part of the recognition algorithm itself, e.g., isolated utterances or phonemes. As a pattern matching technique, VQ is used as a building block to estimate prestored parameters that describe spoken phonemes or words.

Finally, Part 6 contains a collection of papers describing the hardware side of implementing VQ in real systems. One of the attractive features of VQ is its ease of implementation, whereas one of its drawbacks is its inherently large computational complexity. While many of the structured VQ techniques can reduce complexity, the hardware implementation is the final determination of whether a scheme will work in real-time. Many applications of VQ as-

sume real-time operation, such as speech and video coding, where others such as archiving images and store-and-forward voice systems might not require it. The papers in this section include VLSI and other implementations and give the reader a good background on the current state of hardware technology. This in turn drives the theoretical research efforts.

At the end of this collection of papers, Abut has compiled an extremely useful, extensive, and perhaps nearly exhaustive, bibliography of 705 VQ papers, as well as helpful subject and author indexes. Two papers not included in the collection that have attracted a lot of interest are on tree-structured VQ, a low complexity constrained variation of VQ: *Speech Coding Based on Vector Quantization*, by Buzo, Gray, Gray, and Markel, IEEE Trans. on Acoustics, Speech, and Signal Proc., Oct. 1980; and *Optimal Pruning with Applications to*

Tree-Structured Coding and Modeling, by Chou, Lookabaugh, and Gray, IEEE Trans. on Info. Thy., March 1989. One minor criticism is that a small number of the papers included in this collection seem to be not as significant as some of the more "classical" reprints that were not included.

In summary, Abut's collection of papers is invaluable to anyone with an interest in vector quantization or its many applications such as data compression, speech, image, video, and music coding, pattern and speech recognition, and statistical cluster analysis. Besides this collection, those with an interest in VQ can find more recent work in the IEEE Transactions on Signal Processing, the IEEE Transactions on Information Theory, and the IEEE Transactions on Communications, among others, and in the new textbook *Vector Quantization and Signal Compression*, by Gersho and Gray (Kluwer 1992).

Conference Calendar

DATE	CONFERENCE	LOCATION	CONTACT	DUE DATE
Mar. 28-Apr. 1 1993	1993 IEEE INFOCOM	San Francisco California	Mike Hluchyuj Motorola Codex MS C2-15 20 Cabot Boulevard Mansfield, MA 02048 Tel: 617-821-7925; Fax: 617-821-4218	
April 27-30 1993	1993 International Conference on Acoustics, Speech, and Signal Processing	Minneapolis Minnesota	M. Kaveh University of Minnesota Department of Elect. Engineering Minneapolis, Minnesota. Tel: 612-625-0720	
May 10-14 1993	10th International Symposium on Applied Algebra, Algebraic Algorithms, and Error Correcting Codes	Puerto Rico	Oscar Moreno Dept. of Mathematics Univ. of Puerto Rico Rio Piedras, Puerto Rico 00931 Tel: 809-751-0625; Fax: 809-765-3263 Email: o_moreno@upr1.upr.clu.edu	
May 23-26 1993	1993 IEEE International Conference on Communications (ICC'93)	Geneva Switzerland	Peter Leuthold Institut fur Kommunikationstechnik ETH_Zentrum CH-8092 Zürich Switzerland Tel: 41-1-256-2788; Fax: 41-1-262-0943	8/31/92
June 2-4 1993	1993 American Control Conference	San Francisco California	Abraham H. Haddad Dept of EECS Northwestern University Sheridan Road Evanston, IL 60208-3118 Tel: 708-491-3641; Fax: 708-491-4455 Email: ahaddad@eecs.nwwu.edu	