EFFICIENT VECTOR QUANTIZATION OF LPC PARAMETERS FOR HARMONIC SPEECH CODING

by

Bhaskar Bhattacharya

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY
in the School
of
Engineering Science

SIMON FRASER UNIVERSITY
October, 1996

APPROVAL

Name: Bhaskar Bhattacharya

Degree: Doctor of Philosophy

Title of thesis : Efficient Vector Quantization of LPC Parameters for Harmonic Speech Coding

Examining Committee: Dr. John Jones, Chairman

Dr. Vladimir Cuperman, Senior Supervisor
Professor, Engineering Science, SFU

Dr. Paul Ho, Supervisor
Associate Professor, Engineering Science, SFU

Dr. Jacques Vaisey, Supervisor
Assistant Professor, Engineering Science, SFU

Dr. Jim Cavers, Internal Examiner
Professor, Engineering Science, SFU

Dr. Sanjit K. Mitra, External Examiner
Professor, Electrical and Computer Engineering
University of California, Santa Barbara

Date Approved: October 11, 1996

Title of Thesis/Project/Extended Essay

"Efficient Vector Quantization of LPC Parameters for Harmonic Speech Coding"

Author:

(signature)

(name)

October 11, 1996
(date)

Abstract

The present thesis deals with the problem of efficient (in bit rate and computational complexity) quantization of Linear Prediction Coding (LPC) parameters for low bit rate speech coding. The thesis introduces a new LPC quantization technique based on the Multi-Stage Vector Quantization (MSVQ) combined with a multi-candidate M-L search. The resulting procedure is assessed by evaluating the quantization spectral distortion on a speech data-base and by evaluating the subjective speech quality of a low-rate speech coder which employs the MSVQ LPC quantization.

The general structure of MSVQ is described along with a geometrical interpretation to provide insight into the structure of the reproduction alphabet in MSVQ. In particular, it is shown that MSVQ codevectors provide a tiling of the sample space with repetitive patterns. Two tree-search techniques are suggested and one of them, the M-L search technique is studied in more detail.

The experimental results obtained with MSVQ indicate that transparent quantization of LSFs (Line Spectral Frequencies - an efficient LPC representation) can be achieved with just 22 bits/vector with computational complexity comparable to the Split VQ at 24 bits/vector. Alternatively, transparent quantization of LSFs can be done using 24 bits/vector (as is done using Split VQ) at a much lower computational complexity. Several results relating performance and complexity trade-offs are reported showing that MSVQ is a very flexible approach which provides a wide range of performance-complexity trade-offs and good robustness.

The performance of MSVQ codes have been studied under channel error conditions and codebook ordering using pseudo-Gray coding. It is shown that while VQ based systems have lower average spectral distortion and a lower percentage of 2-4 dB outliers even with transmission errors, scalar quantization may lead to a lower percentage of 4 dB outliers particularly at high error rates.

Performance of the MSVQ codes have also been studied for effects of language and input spectral shape. It has been shown that MSVQ codes become more robust as the number of stages are increased.

Finally, one of the MSVQ codes developed here has been used to implement a 1800 bps speech coder using a harmonic coding of excitation and a very coarse 0-bit quantization of harmonic spectral shape. The speech quality of the 1800 bps coder was better than the 2400 bps LPC-10e coder.

DOCKET ALARM

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts

Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research

With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips

Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

WHAT WILL YOU BUILD? | **sales@docketalarm.com** | **1-866-77-FASTCASE**

fastcase®
Smarter legal research.