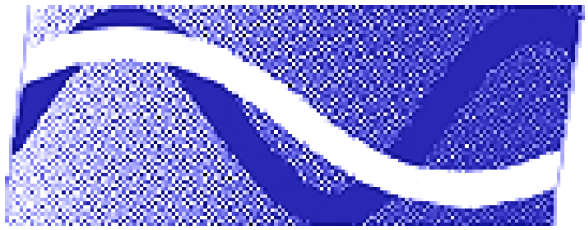

INSTITUT
FÜR NACHRICHTENTECHNIK
UND HOCHFREQUENZTECHNIK
TECHNISCHE UNIVERSITÄT WIEN

DOKUMENTATION

STAND:
1. OKTOBER 1995

INHALT / CONTENTS

Diese Dokumentation ist auch am **World Wide Web** einsehbar:/
This Documentation is also available at the **World Wide Web:**
URL: “http://info.tuwien.ac.at/nthft/doku/doku.html”

Institut für Nachrichtentechnik und Hochfrequenztechnik
Technische Universität Wien
Gußhausstraße 25/389
A-1040 Wien, Austria

Tel.: (+43 1) 588 01-ext.
Fax: (+43 1) 587 05 83
E-mail: sekinthf@email.tuwien.ac.at

	Nebenstelle/ Extension
Sekretariat / Secretary (Fr. Heigl, Fr. Gattermann)	3530
o Codierung und Datenübertragung / Coding and Data Communications Prof. Weinrichter	3528
o Digitale Filter und Signalprozessoren / Digital Filters and Signal Processors Dr. Doblinger	3527
o Digitale Signalverarbeitung / Digital Signal Processing Prof. Mecklenbräuker	3537
o Hochfrequenztechnik / Radio Frequency Technology Prof. Bonek, Prof. Scholtz	3536, 3545
o Mikrowellentechnik / Microwave Engineering Prof. Magerl	3540
o Mobilkommunikation / Mobile Communications Prof. Bonek	3536
o Optische Nachrichtentechnik / Optical Communications Prof. Leeb	3553
o Sprachverarbeitung / Speech Processing Dr. Kubin	3512
o Zeit-Frequenz-Signalverarbeitung / Time-Frequency Signal Processing Dr. Hlawatsch	3515

Professoren:

O.Univ.Prof. Dr. Ernst Bonek
O.Univ.Prof. Dr. Wolfgang Mecklenbräuker
AO.Univ.Prof. Dr. Walter Leeb
AO.Univ.Prof. Dr. Gottfried Magerl
AO.Univ.Prof. Dr. Johann Weinrichter

Dozent:

AO.Univ.Prof. Dr. Arpad Scholtz

Beamte des wissenschaftlichen Dienstes:

Dr. Walter Ehrlich-Schupita

Universitätsassistenten:

Dipl.-Ing. Hans-Peter Bernhard
Dipl.-Ing. Martin Birgmeier
Dr. Gerhard Doblinger
Dipl.-Ing. Martin Hagenauer
Dr. Franz Hlawatsch
Dr. Gernot Kubin
Dipl.-Ing. Klaus Kudielka
Dr. Andreas Molisch
Dipl.-Ing. Heinz Novak
Dipl.-Ing. Bernhard Oehry
Dipl.-Ing. Wolfgang Pusch
Dipl.-Ing. Ralph Sucher

Vertragsassistenten:

Mag. Dipl.-Ing. Josef Fuhl
Dipl.-Ing. Anton Helm
Dipl.-Ing. Bernhard Ingruber
Dipl. Ing. Thomas Keznikl
Dipl.-Ing. Werner Kreuzer
Mag. Dr. Bernhard Mayr
Dipl.-Ing. Martin Schreiblehner

wiss. Mitarbeiter:
Dipl.-Ing. Helmut Bölcskei
Dipl.-Ing. Wolfgang Konrad
Dipl.-Ing. Gerald Matz
Dipl.-Ing. Michael Rasztovits-Wiech
Dr. Bernhard Wess

Bedienstete des nichtwissenschaftlichen Dienstes:

Wolfgang Aue
Johann Enzinger
Monika Fritz
Irene Gattermann
Manuela Heigl
Regine Hodza
Martha Jarosch (karenziert)
Ing. Walter Schüttengruber
Christine Skerbinz
Friederike Svejda
Franz Vasina
Ing. Bernhard Wistawel

Zugeteilt dem Institut:

Hon.Prof. Dr. Hermann Ebenberger
Em.O.Prof. Dr. Günther Kraus
Univ.Doz. Dr. Johannes Riegl
O.Prof. Dr. Gerhard Schiffner
O.Prof. Dr. Heinz Zemanek

Lehrbeauftragte:

Dr. Joseph Braunbeck
Dr. Peter Fröhling
Dr. Heinrich Garn
Dipl.-Ing. Helmut Geirhofer
Dipl.-Ing. Otto Horak
Dr. Markus Kommenda
Dr. Peter Kreuzgruber
Dr. Wolfgang Lothaller
Dr. Helmut Malleck
Dr. Peter Proksch
Dr. Alexander Renner
Dipl.-Ing. Paul Skritek

Im letzten Jahr sind folgende Mitarbeiter ausgeschieden:

Dipl.-Ing. Hubert Egger
Dr. Peter Kreuzgruber
Dipl.-Ing. Mathias Lang
Dr. Vlatko Lipovac
Dr. Werner Pritzl
Dipl.-Ing. Norbert Rohringer
Dr. Gerhard Schultes
Dipl.-Ing. Werner Simbürger
Adelheid Straubinger

Im Bereich der *digitalen Signalverarbeitung* bearbeiten wir derzeit die folgenden Schwerpunkte. Wir untersuchen den Einsatz adaptiver Filter zur Entstörung von Signalen. Für die automatische Umsetzung von Datenflußgraphen in optimierte Programme für Signalprozessoren werden Algorithmen entwickelt. Auf diesem Gebiet besteht eine enge Zusammenarbeit mit einer österreichischen Industriefirma, es unterstützen uns auch der FWF und die OeNB. Zur Analyse und Verarbeitung instationärer Signale wenden wir Zeit-Frequenz-Darstellungen an. Diese Arbeiten werden augenblicklich durch mehrere FWF-Projekte ermöglicht. Unregelmäßige Signale werden mit Methoden der Chaostheorie analysiert. Anwendungen werden mit mehreren Universitätsinstituten und mit der österreichischen Industrie untersucht. Neurale Netze dienen zur Kanalentzerrung, Nachbildung chaotischer Systeme und nichtlinearer Prädiktion und Synthese von Sprachsignalen. Genetische Algorithmen werden zusammen mit neuralen Netzen zur Optimierung von Faltungscodes eingesetzt. Zur Entstörung von verrauschten Bildern werden nichtlineare adaptive Filter und Fuzzy-Methoden verwendet. Phonetisches Spezialwissen setzen wir für die Erzeugung synthetischer Sprache sowie zur Sprechererkennung, Sprachentstörung und Sprachcodierung ein.

Our current activities within the broad framework of *digital signal processing* are dedicated to the following fields. We study the application of adaptive filtering methods to signal enhancement. Algorithms are being developed for the automatic translation of data flow graphs into optimized DSP programs. In this field there is a close cooperation with Austrian industry, we are supported also by projects of FWF and OeNB. We apply time-frequency representations to the analysis and processing of time-varying signals. These investigations are possible by FWF-projects. Irregular signals are analyzed by chaos theory methods, applications are investigated in cooperation with Austrian University departments and Austrian industry. Neural networks are used for equalizing communication channels, for emulating chaotic systems, and for prediction and re-synthesis of speech signals. Genetic algorithms, in combination with neural networks, are applied to the optimization of convolutional codes. Nonlinear adaptive filters and fuzzy techniques are used for enhancement of noisy images. Our knowledge of phonetics is put to use in speech synthesis, as well as in speaker recognition, enhancement, and coding.

Im Bereich der *Kanalcodierung* untersuchen wir Trellis-codierte Modulation für unterschiedliche Kanäle (z.B. Fading-Kanäle) sowie fehlerkorrigierende Übertragungsverfahren mit gezielter Formung des Leistungsdichtespektrums. Im Bereich der Quellencodierung testen wir verschiedene Varianten der Lempel-Ziv Codierung und arbeiten an einer optimalen Kombination von Quellen- und Kanal-Codierung.

In the area of *channel coding* we investigate Trellis Coded Modulation for specific channels (e.g. fading-channels) as well as error correction methods combined with spectral shaping. We are furthermore testing several universal source coding algorithms and try to combine source coding and channel coding in an optimal way.

Auf dem Gebiet der *Mobilkommunikation* arbeiten wir mit der Österreichischen Post- und Telegraphenverwaltung und Industriefirmen zusammen auf den Gebieten Intelligente Antennen, Wellenausbreitung, Feldstärkevorhersage und digitale Mobilfunksysteme (DECT, GSM, Hiperlan). Wir nehmen aktiv an der COST Aktion 231 "Evolution of Land Mobile (including Personal) Communications" teil. Die Kommission der EG beauftragt uns regelmäßig mit der Begutachtung von Projekten im Rahmen der RACE und DRIVE Programme.

In the field of *mobile communications*, we cooperate with the Austrian PTT on antennas, wave propagation and on field strength prediction, and with industry on digital mobile radio (DECT, GSM, Hiperlan). We actively contribute to COST 231 "Evolution of Land Mobile (including Personal) Communications". For the Commission of EC we participate in the annual reviews of research projects within RACE and DRIVE programs.

Auf dem Gebiet der *Hochfrequenztechnik* beschäftigen wir uns mit Sendeempfängern einerseits für Kurzwelle und andererseits für Frequenzbänder bis zu mehreren GHz. In allen Fällen steht der Einsatz digitaler Verfahren im Vordergrund. Selbstverständlich streben wir an, die entwickelten Baugruppen hochintegrierbar zu gestalten.

In the domain of *radio frequency technology* we deal with shortwave radio on one hand and with the exploitation of bands up to several GHz on the other. In both cases we employ digital technology wherever possible. Our main goal is to develop systems which are highly integratable.

Im Bereich der Mikrowellentechnik stehen Industrieaufträge zur Entwicklung von Mikrowellen-Anlagen im Vordergrund. Derzeit wird ein Leistungsverstärker für 1,6GHz entworfen und aufgebaut, der nach dem Prinzip der Beeinflussung der Harmonischen arbeitet. Es wurde ein Wirkungsgrad von besser als 75% erreicht.

Our *microwave group* thrives on industrial contracts for the development of microwave systems. At present we design and build a power amplifier for the 1.6GHz frequency range. It is a harmonic control amplifier, and we obtained a power-added efficiency of better than 75%.

Auf dem Gebiet der *Optischen Nachrichtentechnik* setzen wir zur Zeit zwei Forschungsschwerpunkte. Zum einen entwickeln wir im Auftrag der Europäischen Weltraumbehörde ESA eine optische, phasengesteuerte Antennengruppe für Datenübertragungssyteme mittels Laserlicht. Zum anderen beteiligen wir uns am ACTS-Projekt "PHOTON" der Europäischen Kommission, in dem ein Wellenlängenmultiplexsystem mit Datenraten von 10Gbit/s aufgebaut wird.

In the area of *optical communications* we currently work on two main research projects. First, we develop an optical phased array antenna to be used in the European Space Agency's (ESA) intersatellite communication links. Second, we participate in the European Commission's ACTS project "PHOTON", where a wavelength-multiplexed system with data rates of 10Gbit/s is implemented.

PREISTRÄGER DES INSTITUTS / AWARDS (1.10.1994 - 30.9.1995)

Dipl. Ing. Heinrich Kirchauer	ÖVE/GIT-Preis	1994

1. PFLICHTLEHRVERANSTALTUNGEN / MANDATORY COURSES

			WS	SS
Bonek:	Wellenausbreitung 1	VO	2,0	—
Bonek mit Rohringer:	Wellenausbreitung 1	UE	1,0	—
Magerl:	Wellenausbreitung 2	VO	—	2,0
Magerl mit Oehry:	Wellenausbreitung 2	UE	—	1,0
Bonek, Mecklenbräuker, Seifert:	Nachrichtentechnik Labor B	LU	9,0	—
Bonek:	Nachrichtentechnik Labor für TPH	LU	—	4,0
Leeb:	Optische Nachrichtentechnik	VO	2,0	—
Leeb mit Kudielka:	Optische Nachrichtentechnik	UE	1,0	—
Bonek:	Hochfrequenztechnik 1	VO	—	2,0
Bonek mit Novak:	Hochfrequenztechnik 1	UE	—	1,0
Geirhofer:	Telekommunikationsnetze und -dienste	VO	—	1,5
Malleck:	Vermittlungstechnik	VO	—	2,0
Mecklenbräuker:	Signal- und Systemtheorie 1	VO	1,5	—
Mecklenbräuker mit Kubin:	Signal- und Systemtheorie 1	UE	1,0	—
Mecklenbräuker:	Signal- und Systemtheorie 2	VO	—	1,5
Mecklenbräuker mit Doblinger:	Signal- und Systemtheorie 2	UE	—	1,0
Mecklenbräuker:	Übertragungsverfahren 1	VO	2,0	—
Mecklenbräuker mit Bernhard:	Übertragungsverfahren 1	UE	1,0	—
Mecklenbräuker:	Übertragungsverfahren 2	VO	—	2,0
Mecklenbräuker mit Hlawatsch:	Übertragungsverfahren 2	UE	—	1,0
Mecklenbräuker, Bonek:	Nachrichtentechnik Labor B für Computertechnik	LU	3,5	—
Mecklenbräuker, Bonek, Seifert:	Nachrichtentechnik Labor A	LU	—	5,0
Scholtz:	Hochfrequenztechnik 2	VO	2,0	—
Scholtz mit Ehrlich-Schupita:	Hochfrequenztechnik 2	UE	1,0	—
Weinrichter:	Einführung in die Nachrichtentechnik	VO	—	3,0
Weinrichter mit Sucher:	Einführung in die Nachrichtentechnik	UE	—	1,5
Weinrichter:	Grundlagen nachrichtentechn.Signale	VO	—	2,0
Weinrichter mit Birgmeier:	Grundlagen nachrichtentechn.Signale	UE	—	1,0

2. WAHLLEHRVERANSTALTUNGEN / OPTIONAL COURSES

			WS	SS
Bonek:	EDV-orientierte Projektarbeit für ET	AG	4,0	4,0
Bonek mit Schultes:	Mobilkommunikation	SV	2,0	—
Bonek, Leeb:	Elektrotechnisches Englisch anhand ausgewählter Beispiele der Hochfrequenztechnik	KO	2,0	—
Bonek, Leeb	Englischsprachiges Veröffentlichen in der ET	KO	—	2,0
Bonek, Magerl	Sicherheitsaspekte im Umgang m. elektromagnetischen Feldern für TUSCH	SV	—	2,0
Bonek, Weinrichter, Scholtz:	Mobilfunk	KO	—	3,0
Bonek, Weinrichter, Scholtz:	Mobile Radio Communications	KO	—	3,0
Braunbeck:	Geschichte der Nachrichten-technik	VO	1,5	—
Doblinger:	Signalprozessoren	VO	1,5	—
Doblinger, Helm:	Programmieren von Signalverarbei-tungsalgorithmen in C	SE	—	1,5
Ebenberger:	Vermittlungssysteme	VO	1,5	—
Fröhling, Renner:	Numerische Methoden in der HF- und Mikrowellentechnik	VO	1,5	—
Garn:	EMV-Probleme in NT., Signal- und Datenverarbeitung	VO	—	1,5
Garn:	EMV-Probleme in NT., Signal- und Datenverarbeitung	UE	—	1,5
Haslinger:	Neue Telekommunikationsdienste	VO	1,5	—
Hlawatsch:	Time-Frequency Methods for Signal Processing	VO	1,5	—
Kommenda:	Ein- und Ausgabe von Sprache	VO	—	2,0
Kreuzgruber	Meßgeräte der Hochfrequenztechnik B	KO	—	1,5
Kubin:	Chaotic Signal Processing	VO	—	1,5
Kubin:	Adaptive Signal Processing	VO	1,5	—
Leeb:	EDV-orientierte Projektarbeit für ET	AG	4,0	4,0
Leeb:	Glasfaser-Nachrichtensysteme	VO	—	1,5

			WS	SS
Lothaller:	Satellitennachrichtentechnik	VO	—	1,5
Magerl:	Mikrowellenmeßtechnik	SE	1,5	—
Magerl:	Integrierte Mikrowellen-schaltungen	VO	—	1,5
Magerl mit Pritzl:	EDV-orientierte Projektarbeit für ET	AG	4,0	4,0
Mecklenbräuker:	EDV-orientierte Projektarbeit für ET	AG	4,0	4,0
Mecklenbräuker:	Netzwerktheorie	VO	1,5	—
Mecklenbräuker, Birgmeier Doblinger:	Digitale Signalverarbeitung A	SE	3,0	—
Mecklenbräuker, Birgmeier Doblinger:	Digitale Signalverarbeitung B	SE	—	3,0
Mecklenbräuker:	Digitale Signalverarbeitung	VO	—	1,5
Proksch:	Phasenregelschleifen in der Nachrichtentechnik	VO	—	1,5
Riegl:	Radartechnik	VO	—	1,5
Scholtz:	Hochfrequenz-Schaltungstechnik	VO	—	1,5
Skritek:	Computerunterstützter Schaltungs-entwurf	VO	—	1,5
Weinrichter:	EDV-orientierte Projektarbeit für ET	AG	4,0	4,0
Weinrichter:	Einführung in die Codierung	VO	2,0	—
Weinrichter:	Filter	VO	1,5	—
Wess:	Dimensionierung und Simulation analoger Filter	SE	—	1,5
Zemanek:	Geschichte der Informatik	VO	1,5	—
Zemanek:	Menschliche Aspekte des Computers	VO	1,0	—

Codierung und Datenübertragung / Coding and Data Communications

Coding techniques for fading channels.
Contact: B.J. Mayr Partner: FWF (Project P10294-ÖPY) Duration: 01.10.94 - 30.09.96

Spectrally shaped codes with good distance properties.
Contact: W. Pusch Partner: — Duration: 01.09.91 - 31.03.97

Digitale Signalverarbeitung / Digital Signal Processing

Application of neural networks in telecommunications.
Contact: M. Birgmeier Partner: — Duration: 01.09.92 - 31.08.96

Applications of digital signal processing to communications.
Contact: G. Kubin Partner: COST 229 Duration: 1991 - 1994

Automatic code generation for processors with parallel computational units.
Contact: B. Wess Partner: OeNB (Project 5491) Duration: 15.07.95 - 30.08.96

Code generation for digital signal processors.
Contact: A. Helm Partner: SIEMENS Duration: 01.02.93 -

Digital signal processing in data transmission facilities.
Contact: W. Kreuzer Partner: ERICSSON/SCHRACK Duration: 01.10.93 -

Generation of optimized DSP assembly programs.
Contact: B. Wess Partner: FWF (Project P10701-ÖTE) Duration: 16.09.95 -

Mikrowellentechnik / Microwave Engineering

High efficiency solid state power amplifier for L-band.
Contact: G. Magerl Partner: Hirschmann Electronic GmbH and ESA Duration: 01.02.94 - 31.03.96

Atomic line filters.
Contact: G. Magerl Partner: ESA-ESTEC Duration: 07.92 - 06.94

Mobilkommunikation / Mobile Communications

Evolution of land mobile (including personal) communications.
Contact: E. Bonek Partner: COST 231 Duration: 1989 - 04.96

Mobile radio communications.
Contact: E. Bonek Partner: FWF (Project P8851) Duration: 01.11.92 - 31.03.95

Telecommunications.
Contact: E. Bonek Partner: ÖPTV Duration: 1990-

Optische Nachrichtentechnik / Optical Communications

Advanced coherent optical receiver.
Contact: W. Leeb Partner: ESA-ESTEC Duration: 01.03.92 - 01.04.95

Optical phased array telescope.
Contact: W. Leeb Partner: ESA-ESTEC Duration: 01.08.94 - 01.08.97

Sprachverarbeitung / Speech Processing

Acoustic signal generation for the text-to-speech system GRAPHON.
Contact: Th. Keznikl Partner: FWF (Project P9745-PHY) Duration: 01.11.93 - 31.01.96

Signal analysis and modelling using chaos theory methods.
Contact: G. Kubin Partner: FWF (Project P8779) Duration: 1992 - 1995

Zeit-Frequenz-Signalverarbeitung / Time-Frequency Signal Processing

Time-frequency methods for statistical signal processing.
Contact: F. Hlawatsch Partner: FWF (Project P10012-ÖPH) Duration: 01.05.94-

Matched time-frequency signal representations.
Contact: F. Hlawatsch Partner: FWF (Projekt P10531-ÖPH) Duration: 01.06.95 -

FRIMPONG George Kofi: Error-Correcting, DC-Free Line Codes

In certain communication systems, low frequency components cannot be transmitted. In such cases, digital information has to be processed in such a way that the low frequency components of the power density spectrum are strongly suppressed. In conventional systems, this is usually performed by means of specific line codes such as ternary AMI or HDBn codes or using partial response filtering. In order to combat statistical disturbances on the channel in the modern communication systems, error correcting outer codes like Reed-Solomon codes or convolutional codes are used in addition to spectral shaping line codes. Obviously, in both of these codes, redundancy must be inserted in order to obtain the desired properties.

The main goal of this thesis is to combine error-correcting capability and spectral shaping in order to make the best use of the added redundancy. In Chapter 2 of this work, the most important conventional methods of concatenation of error correction codes and spectral shaping methods are described. In the next three chapters, newly developed combined codes for error correction as well as spectral shaping are presented. Chapter 3 is devoted to BPSK-codes, Chapter 4 to 4PAM-codes, and Chapter 5 to QPSK-codes. The new codes operate at information rates of 1/3 to 4/4 information bits per symbol. Hamming distances from 3 to 5 symbols and total disparities bounded either to 0 or to ±1 or to ± 2 are obtained. This corresponds to asymptotic coding gains from -1,3 to +2,22dB.

The simulated residual error rates obtained by means of soft decision as well as hard decision decoding methods are shown in Chapter 3, 4 and 5 and compared to conventional schemes in Chapter 7. The resulting bit error rates of our new codes compare favorably with traditional results.

The power density spectra of our codes are presented in Chapter 6, clearly demonstrating the suppression of low frequencies due to bounded code disparities.

WOKUREK Wolfgang: Sprachentstörung unter Verwendung eines Lautklassendetektors

Speech enhancement by the adaptive Wiener-filter method is improved by adding a sound class detector and spectral estimators, based on subspace representations of the sound classes. The speech enhancement system is based on a filter bank implementation of the adaptive Wiener-filter. The short-time energies of the bandpass output signals of the filter bank are used to define a feature vector. Vowels and fricatives are considered as two sound classes and the typical regions of their feature vectors are approximated by subspaces. The sound class detector is based on these subspace representations of the sound classes. The experiments show that each sound class can be represented by a single low dimensional subspace of the feature vector space.

The subspace representations of the sound classes are also used in the spectral estimator. Speech power estimates and noise power estimates are calculated by projecting the feature vector to the subspace of the actual sound class. Both power estimates are necessary to obtain the channel gain factors of the adaptive Wiener-filter. Psychoacoustic scales are implemented in the filter bank and in the feature vector definition. The sound class detector is not improved by the bark scale or the sone scale.

The new speech enhancement method does not produce the musical tone structure of the residual noise. It needs a minimum signal to noise ratio of 3dB. The speech enhancement systems are evaluated and compared by a formal listening test. A simplified rhyme test is used to evaluate the sound confusion rates. The new method has a lower sound confusion rate, compared to the adaptive Wiener-filter.

BÜHLER Hermann: Estimation of Radio Channel Time Dispersion for Mobile Radio Network Planning

This work proposes, describes and implements a special technique to identify areas of heavy time dispersion using terrain data available from digital topographical databases. This technique is called "Path Tracing". The main possible paths along which the transmitted radio wave can propagate from transmitter antenna to receiver antenna are traced within the three-dimensional terrain.

Propagation between transmitter and scattering area, and scattering area and receiver is modelled as free-space. For the scattering process, different models have been chosen: An isotropic half-space radiator, a Lambert scatterer, and a Gaussian-distributed rough scattering surface are available as software modules. Only single reflections are considered.

The results of this estimation technique should be interpreted as an average over a receiving area.

The principal results are:
- "Path List"
  (Along which paths do waves actually arrive at the receiver?)
- "Power Origin Plot"
  (What power is reflected to the receiver from which terrain location?)
- "Power Delay Plot"
  (At what time do reflections arrive at the receiver from which terrain location?)
- "Power Delay Profile"
  (What power arrives at what excess delay (relative to first path) at the receiver?)
- Further parameters derived from processing of power delay profiles (delay windows, ...)

Prediction results compare very well with measured data for the detection of dominant reflected paths. Determination of the power of a single path is affected by some uncertainty, since the result is derived by concatenating three processes (propagation-scattering-propagation), each of them with considerable uncertainty.

The requirements for topographical databases and the obtaining of land cover data for mobile radio network planning are discussed in the appendices.

The Path Tracing technique was implemented in a software package called DISP. The software runs on personal computers under DOS in protected mode (DPMI). The status of the calculation is continuously reported to the user. Batch processing is provided. Calculation control is performed by a text file, generated by any standard text editor. All results are available for further processing by other software tools.

ROHRINGER Norbert: Parameter Extraction for Large-Signal Modelling of Bipolar Junction Transistors

This thesis studies quick and efficient parameter extraction for microwave bipolar junction transistors biased in forward active region. The parameter extraction algorithm using the extended SPICE Gummel/Poon model is based on S-parameters measured in a wide frequency range at one or several bias settings only. It focuses on a method that extracts a small-signal model for every measured bias setting and calculates the large-signal parameters using curve-fitting. A pre-extraction procedure uses measured data to obtain accurate estimations for the small-signal parameters calculated in the following optimization process. The developed algorithm was implemented in a Microsoft Windows™ program by the use of BORLAND PASCAL™ 7.0 for the sake of speed, but can easily be implemented by the use of well known scientific and engineering numeric computation software as for instance MATLAB™. The parameter extraction can be performed automatically.

An entirely new concept was introduced to determine the consistency of a parameter extraction algorithm. This thesis developed a Monte Carlo test routine that studies the uncertainty introduced by the extraction algorithm itself. This test routine isolates this uncertainty from the uncertainty introduced by measurement errors. Such a consistency analysis is a valuable tool to decide which parameters to choose for extraction and it helps to enhance any extraction method in the development stage. At present time the road block is that a model that is valid in a large bias range needs 20 and even more parameters and that a consistency analysis of an extraction method which is based on more than 8 S-parameter data sets and extracts more than 13 parameters requires excessive computation time. But the increasing computation speed will eliminate this disadvantage in a few years.

The consistency analysis of a parameter extraction based on S-parameter measurements in the frequency range from 25MHz to 8GHz at typical bias settings over a wide range of parameter values yields the result that DC-parameters like the ideal maximum forward beta BF, and the forward Early voltage VAF can be accurately extracted. The use of more S-parameter data sets facilitates the extraction of the corner for forward beta high current roll off IKF.

Three application examples illustrate the usefulness of the parameter extraction method. The model parameters of a SIEMENS prototype transistor and two microwave transistors fabricated by ADVANTEK were extracted. The study of small-signal prediction capability of the extracted model showed that, at a low and medium current regime, the SPICE-Gummel/Poon model accurately predicts small-signal parameters, whereas at high current regime it becomes inaccurate. The extracted models accurately predicted S-parameters over a wide range of bias with the collector current lower than IKF. An examination of the predicted forward transit time showed that the empirical expression used by the SPICE-Gummel/Poon model to simulate the bias dependent base-emitter diffusion capacitance is highly inaccurate too. Noise parameter prediction was in good agreement with measurements. Intermodulation and compression measurements served as large-signal model validation.

The maximum mismatch between the measured and the simulated 1dB compression point was lower than 2.5dB. The measured and the simulated third order intermodulation of the devices with no additional circuitry and a two-stage broad-band amplifier showed a very good match. The simulated and the measured output voltage and the tuning characteristic of a 1.8GHz DECT-frequency band VCO were in excellent agreement.

With some modifications the method described in this thesis can be used to extract parameters for newer bipolar transistor models that are more accurate. The strategy developed can also be applied to field effect transistors (FETs) and high electron mobility transistors (HEMTs).

MOLISCH Andreas: Modelling and Simulation of Lamp-pumped Thallium Atomic Line Filters

Atomic Line Filters (ALFs) are ultra-narrow-band, wide-field-of-view optical filters for the detection of weak optical signals embedded in broadband background noise. The central component is a quartz cell filled with an atomic vapor, where signal photons are absorbed and subsequently reemitted at a different wavelength. At the Institut für Nachrichtentechnik und Hochfrequenztechnik, an ALF based on Thallium (Tl) vapor, which is pumped by a Tl spectral lamp, has been under development. The aim of this thesis is to model the physical processes in this filter (especially in the vapor cell) and to make simulations in order to find the optimum design. For this purpose, a theoretical "toolbox" is to be created, which should be capable of describing quantitatively the various physical effects. The accuracy of the simulation should be about ±10%, i.e. about the accuracy of the available atomic data.

In the course of the work, it turned out that the incorporation of the radiative transfer in the vapor cell and the repeated absorption-reemission processes of the photons (radiation trapping) are vital for a correct description, so that a considerable part of the thesis deals with trapping. The "tools" developed in this context are applicable not only for the simulation of the Tl-ALF, but also for some other problems where trapping is involved, i.e. in atomic and molecular spectroscopy, atomic physics, and chemical physics.

In order to keep the computer time that is necessary for the simulations within reasonable bounds, mathematical approximations are used for the solution of the equations describing the behavior of the filter. Whenever we use such an approximation, or a simplifying assumption for the physical modelling, we tried to answer the following questions : (i) what is the assumption, (ii) when is it justified, (iii) how large is the error, (iv) what can we do to get exact results. Monte Carlo simulations often provide the answer to (iii) and (iv) and are used extensively throughout this thesis. Furthermore, they are an independent computational method and are used to establish the validity of the computations.

In Part I, the physics that form the basis of ALFs are briefly explained. In Chapt. 1, the principle of an ALF is explained, and the parameters that describe such filters are defined. In the next two chapters, atomic energy levels and atomic lineshapes are described. We then summarize the data of the uv and green resonance lines of Thallium. After giving an overview over the methods of description for trapping problems, (Holstein equation, equation-of-radiative-transfer plus rate-equation, Monte Carlo simulation), we describe the (generalized) Milne theory, an approximate method which allows a description of trapping by a differential equation.

In Part II, we then make use of these formalism to describe the Tl-ALF mathematically. After giving a description of the whole filter system, we show the various influences on the lifetime of the metastable Tl atoms. Then, the pump phase of the filter is described. In that phase, we have nonlinear trapping in a 3-level system. This problem is solved by a combination of finite-difference solution of the equation of radiative transfer (in the Milne theory) and iteration. Finally, the performance of the filter during its sensitive phase is simulated.

In Part III, the mathematical description developed in Part II is used for the optimization of a Tl-ALF in a cloud-height-sensing LIDAR system. The way in which the operating parameters determine the performance parameters is described, and the simulations that led to the determination of the optimum operating parameters are depicted. Comparisons with measurements show that the difference between theory and measurement is smaller than the measurement uncertainty. A summary and proposals for future work conclude this thesis.

HIRN Richard **Implementation and Limits of Multimode Fiber Passive Optical Networks**

For use in in-house telecommunication networks, multimode fiber technology is regarded a cost-efficient alternative to singlemode technology. However, potential cost savings must be traded against inherent bandwidth and topology limitations.

This work deals with the implementation and with limits of multimode passive optical networks (PONs). A major disadvantage of multimode PONs is their susceptibility to modal noise. Therefore, this effect is thoroughly investigated. The amplitude density distribution of modal noise as a function of source spectrum, fiber dispersion and network topology is evaluated, and guidelines for the dimensioning of multimode PONs are developed. The figures derived mathematically are compared to experimental results. The experimental part of the work includes an investigation of the modal noise spectrum.

With the experiences gathered in the course of the implementation, further recommendations on multimode PON implementation are made. For instance, the use of gain-guided lasers operating in the 800nm window is recommended while passive components that are transversely mode-selective should be avoided. Nonuniformities of the optical signal attenuation should be coped with by the relevant receivers (burst-mode receivers) rather than by individually controlling the optical transmitters' power.

The work concludes with a consideration of the limits on transmission capacity of multimode PONs. The results indicate that multimode PONs cannot by far attain the bandwidth and flexibility of singlemode PONs.

PRITZL Werner **Bistatisches Radar zur Bestimmung des witterungsbedingten Straßenzustands**

A bistatic radar is developed to determine the weather induced road condition. Situated on opposite sides of a road, it measures at a frequency of 2.45GHz the ellipsometric ratio, which is the ratio of the reflection coefficients of vertical and horizontal polarisation, respectively. The transmitter consists of a dielectrically frequency stabilized transistor oscillator. Planar microstrip antennas are utilized for transmitting and receiving the signals. The receiver uses a six-port to measure the amplitudes and the phase difference of the reflection coefficients. With the developed measurement set-up an accuracy of typically 0.01 in the ellipsometric ratio is achieved. From this data it is possible to distinguish dry from wet, snow or slush covered roads. In case of a wet road the thickness and salinity, and from that the freezing point of a water layer covering the road are evaluated. Several constraints limiting the determination of the road condition are analysed. Most important are freezing water in the road material and inhomogeneous layers covering the road. The first problem can be solved by an adaptive algorithm keeping track of the reflection properties of the road material below 0°C. The detection of an icy road is another yet unsolved problem. In case of a homogeneous layer covering the road, an accuracy of 0.005mm ++/-10% of the measured value can be expected for the determination of the film thickness. Concerning the freezing point errors can be expected to be less than +/-1°C ++/-20% of the measured value (in °C).

BAUER A.	Simulation von Übertragungssystemen; kombinierte Entzerrung und Kodierung bei dichter magnetischer Sättigungsaufzeichnung, 1994.
BÖLCSKEI H.	Gabor expansion and frame theory, 1994.
BUCHMAYR M.	Zweidimensionale digitale Signalverarbeitung, 1994.
GELBARD F.	Laborübung Schwingungsmodulation, 1994.
KHARBOOT L.	Simulation a wide area network using the bones program, 1994.
KREMSL A.	Automatische Sprechererkennung, 1994.
LANG M.	Optimaler Entwurf komplexwertiger nichtrekursiver Digitalfilter, 1994.
MATZ G.	Zeitvariante Spektralanalyse, 1994
MÜLLER H.	Design eines optischen Empfangsantennenexperimentes, 1994.
PFANN E.	Noise shaping data converters, 1994.
SCHUSTER G.	Digitale Regelung einer optischen Antennengruppe, 1994.
AICHRIEDLER M.	Aufbau eines 56 kbit/s Übertragungssystems für 1.3 GHz, 1995.
NOWAK P.	Interne Diversityantennen für Dect-Portables, 1995.
SCHLEGEL Ch.	Gleichstromfreie fehlerkorrigierende Codes, 1995.
SEISER F.	Neuronale Netze für intelligente Antennen, 1995.
BERGER G.	Zeit-Frequenz-Verfahren für die Signaldetektion, 1995.
BOU-VINALS R.	Aufbau einer experimentellen optischen Empfangsantennengruppe, 1995.
GRUDEN A.	Vergleich verschiedener linearer Blockcodes im Rayleigh Fading-Kanal, 1995.
HEBENSTREIT P.	Optischer Heterodynempfänger für 565 MBit/s, 1995.
HUBER H.	Aufbau eines optischen Mehrfach-Leistungsdetektors für eine optische Antennengruppe, 1995.
LANG E.	Reduced State Viterbi Decoder für optimale Faltungscodes, 1995.
MESER J.	Automatische Wortgrenzendetektion für ein Spracherkennungssystem, 1995.
ÖHRENEDER Ch.	Funktionsanalyse des Mikrowellen-Radio-Scatterometers RSM und Signatur-Messungen über alpiner Grasheide, 1995.

BERNHARD, H.-P., Sprachsignalanalyse mit Phasenraummethoden, Fortschritte der Akustik, DAGA´95, Saarbrücken, März 1995, Vol. II, 1015-1018.

BERNHARD, H.-P., Analyse von Sprachsignalen mit Methoden der Chaostheorie, e&i 111 (1994) 648-649.

BÖLCSKEI, H., FEICHTINGER, H.G., HLAWATSCH, F., Diagonalizing the Gabor frame operator, Proc. IEEE-UKRI Symp. Applications of Time-Frequency and Time-Scale Methods, Coventry (UK), Aug. 1995, 249-255a.

BÖLCSKEI, H., HLAWATSCH, F., FEICHTINGER, H.G., Equivalence of DFT filter banks and Gabor expansions, SPIE Proc. vol. 2569, Wavelet Applications in Signal and Image Processing III, San Diego (CA), Juli 1995, 128-139.

CROHN, I., BONEK, E., Suppression of the irreducible errors in a frequency-selective fading channel by fractional-bit differential detection, IEEE Transactions Vehicular Technology 43 (1994) 1039-1048.

DOBLINGER, G., Performance analysis of an adaptive subspace filter for signal enhancement, Proc. 1995 Int. Symp. Circuits and Systems, Seattle, April/Mai 1995, 1086-1089.

DOBLINGER, G., Computationally efficient speech enhancement by spectral minima tracking in subbands, Proc. Eurospeech'95, Madrid, Sept. 1995, Vol.2, 1513-1516.

EHRLICH-SCHUPITA, W., Seitenband-Spektroskopie mit dem CO_2-Laser, Österreichischer Kunst- und Kulturverlag, Dissertationen der Techn. Univ. Wien, Band 58, Wien 1994.

FUHL, J., MOLISCH, A.F., Space domain equalisation for second and third generation mobile radio systems, Proc. 2. ITG Fachtagung Mobile Kommunikation, Neu-Ulm, Sept. 1995, 85-92.

FUHL, J., NOWAK, P., BONEK, E., Improved internal antenna for hand-held terminals, Electronic Letters 30 (1994) 1816-1818.

FUHL, J., BALDUCCI, P., NOWAK, P., BONEK, E., Internal broadband antenna for hand-held terminals with reduced gain in the direction of the user's head, Proc. 1995 IEEE 45th Vehicular Technology Conf., Chicago, Juli 1995, 848-852.

FUHL, J., MOLISCH, A.F., Virtual-image-array single-snapshot (VIASS) algorithm for direction-of-arrival estimation of coherent signals, Proc. 6th IEEE Int. Symp. Personal, Indoor and Mobile Radio Communications, PIMRC'95, Toronto, Canada, Sept. 1995, 658-663.

FUHL, J., MOLISCH, A.F., Minimization of outage probability in cellular communication systems by antenna beam tilting, Virginia Tech's 5th Symp. Wireless Personal Communications, Blacksburg, VA, Mai 1995, 15-1 - 15-12.

HELM, A., WESS, B., Decomposition of signal flow graphs for DSP compilers using trellis trees in restricted environments, Proc. Internat. Conf. on Signal Processing Applications and Technology, ICSPAT'94, Dallas, Texas, Okt. 1994, 677-682.

HLAWATSCH, F., BÖLCSKEI, H., Unified theory of displacement-covariant time-frequency analysis, Proc. IEEE-SP Internat. Sympos. Time-Frequency Time-Scale Analysis, Philadelphia (PA), Okt. 1994, 524-527.

HLAWATSCH, F., KOZEK, W., Time-frequency projection filters and time-frequency signal expansions, IEEE Trans. on Signal Processing 42 (1994) 3321-3334.

HLAWATSCH, F., Covariant time-frequency analysis: A unifying framework, Proc. IEEE-UKRI Symp. Applications of Time-Frequency and Time-Scale Methods, Coventry (UK), Aug. 1995, 110-117.

HLAWATSCH, F., BÖLCSKEI, H., Time-frequency distributions based on conjugate operators, Proc. IEEE-UKRI Symp. Applications of Time-Frequency and Time-Scale Methods, Coventry (UK), Aug. 1995, 187-193a.

HLAWATSCH, F., BÖLCSKEI, H., Displacement-covariant time-frequency energy distributions, Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP-95), Detroit, Mai 1995, 1025-1028.

HLAWATSCH, F., BÖLCSKEI, H., Time-frequency analysis of frames, Proc. IEEE-SP Internat. Sympos. Time-Frequency Time-Scale Analysis, Philadelphia (PA), Okt. 1994, 52-55.

HLAWATSCH, F., KOZEK, W., Second-order time-frequency synthesis of nonstationary random processes, IEEE Trans. on Information Theory 41 (1995) 255-267.

HLAWATSCH, F., MANICKAM, Th.G., URBANKE, R.L., JONES, W., Smoothed pseudo-Wigner distribution, Choi-Williams distribution, and cone-kernel representation: Ambiguity-domain analysis and experimental comparison, Signal Processing 43 (1995), 149-168.

KEZNIKL, Th., Modifikation von Sprachsignalen für die Sprachsynthese, Fortschritte der Akustik, DAGA´95, Saarbrücken, März 1995, Vol. II, 983-986.

KIRCHAUER, H., HLAWATSCH, F., KOZEK, W., Time-frequency formulation and design of nonstationary Wiener filters, Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP-95), Detroit, Mai 1995, 1549-1552.

KOZEK, W., HLAWATSCH, F., KIRCHAUER, H., TRAUTWEIN, U., Correlative time-frequency analysis and classification of nonstationary random processes, Proc. IEEE-SP Internat. Sympos. Time-Frequency Time-Scale Analysis, Philadelphia (PA), Okt. 1994, 417-420.

KREUZGRUBER, P., Störschutzschaltung für Demodulatoren digital modulierter Signale, Patentschrift AT398 658B, Beginn der Gültigkeit: 15.5.1994, Ausgabetag: 25.1.1995.

KUBIN, G., What is a chaotic signal ?, 1995 IEEE Workshop on Nonlinear Signal and Image Proc., Halkidiki, Griechenland, Juni 1995, Vol. I, 141-145.

KUBIN, G., Nekonvencne koncepcie spracovania signalov cislicovom kodovani reci (Nonconventional signal processing concepts for digital speech coding, in Slovak), Proc. AUDIO-TEX Seminar, Slovak Telecom and Slovak Electrical Engineering Association, Bratislava, Nov. 1994, 52-55, Invited Paper.

LIPOVAC, V., MOLISCH, A.F., On the performance of MSK signal transmission over a multipath channel with small time dispersion, Proc. 1995 IEEE 45th Vehicular Technology Conf., Chicago, Juli 1995, 25-29.

MATZ, G., HLAWATSCH, F., KOZEK, W., Weyl spectral analysis of nonstationary random processes, Proc. IEEE-UKRI Symp. Applications of Time-Frequency and Time-Scale Methods, Coventry (UK), Aug. 1995, 120-127.

MAYR, B.J., WEINRICHTER, H., Zusätzliche Codegewinne von 0.5 bis 3 dB im AWGN- und Fading-Kanal durch neue Entwurfmethoden für mehrdimensionale MPSK-TCM Verfahren, Proc. 2. ITG Fachtagung Mobile Kommunikation, Neu-Ulm, Sept. 1995, 493-500.

MOLISCH, A.F., ALLEGRINI, M., OEHRY, B.P., SCHUPITA, W., MAGERL, G., Computation of nonlinear radiation trapping in a saturated cesium vapor, Optics Communications 120 (1995) 149-154.

MOLISCH, A.F., FUHL, J., BONEK, E., Exact computation of the error floor of DBPSK in two-delay mobile radio channels, Proc. 2. ITG Fachtagung Mobile Kommunikation, Neu-Ulm, Sept. 1995, 263-270.

MOLISCH, A.F., FUHL, J., PROKSCH, P., Bit errorprobability of MSK modulation with switched diversity in a mobile-radio channel with two independently-fading paths, Proc. 6th IEEE Int. Symp. Personal, Indoor and Mobile Radio Communications, PIMRC'95, Toronto, Canada, Sept. 1995, 1223-1227.

MOLISCH, A.F., OEHRY, B.P., SCHUPITA, W., MAGERL, G., Radiation trapping in a saturated atomic vapor in cylindrical geometries, Optics Communications 118 (1995) 520-524.

MOLISCH, A.F., FUHL, J., BONEK, E., Pattern distortion of mobile radio base station antennas by antenna masts and roofs, Proc. 25th Europ. Microwave Conf. 1995, Bologna, 71-76.

MOLISCH, A.F., PARKER, G.J., OEHRY, B.P., SCHUPITA, W., MAGERL, G., Radiation trapping with partial frequency redistribution: Comparison of approximations and exact solutions, J. Quant. Spectrosc. Radiat. Transfer 53 (1995) 269-275.

MOLISCH, A.F., SCHUPITA, W., OEHRY, B.P., SUMETSBERGER, B., MAGERL, G., Modeling and efficient computation of nonlinear radiation trapping in three-level atomic vapors, Phys. Rev. A, 51 (1995) 3576-3583.

MOLISCH, A.F., OEHRY, B.P., SCHUPITA, W., SUMETSBERGER, B., MAGERL, G., Efficient computation of simultaneous radiation-trapping and particle diffusion in an atomic vapor, J. Quant. Spectrosc. Radiat. Transfer 52 (1994) 841-846.

PAPANDREOU, A., HLAWATSCH, F., BOUDREAUX-BARTELS, G.F., A unified framework for the scale covariant affine, hyperbolic, and power class quadratic time-frequency representations using generalized time shifts, Proc. IEEE Int. Conf. Acoust., Speech, Signal Processing (ICASSP-95), Detroit, Mai 1995, 1017-1020.

RASZTOVITS, M.M., SCHREIBLEHNER, M.A., SCHOLTZ, A.L., LEEB, W.R., POLACEK, P., Highly sensitive 565Mbit/s optical heterodyne receiver demonstrator for λ=1.064µm with automatic frequency acquisition, SPIE Proc. 2381, Free-Space Laser Communication Technologies VII, San Jose, California, Feb. 1995.

ROHRINGER, N.M., KREUZGRUBER, P., Parameter extraction for large-signal modeling of bipolar junction transistors, Int. J, Microwave and Millimeter-Wave CAD 5 (1995) 161-172.

SCHREIBLEHNER, M.A., RASZTOVITS, M.M., LEEB, W.R., SCHOLTZ, A.L., Experimental and numerical determination of crosstalk in a coherent optical multichannel receiver, SPIE Proc. 2381, Free-Space Laser Communication Technologies VII, San Jose, California, Feb. 1995, 320-329.

SIMBÜRGER, W., KNAPP, H., WEGER, P., Characterization of a microwave silicon single-chip direct conversion RF transceiver, Proc. 25th European Microwave Conf., Bologna, Sept. 1995, 646-657.

SUCHER, R., Removal of impulse noise by selective filtering, Proc. IEEE Int. Conf. on Image Processing 1994, ICIP 1994, Austin, Texas, Nov. 1994, Vol. II, 502-506.

SUCHER, R., A new adaptive nonlinear filtering algorithm, Proc. IEEE Singapore Int. Conf. Signal Processing, Circuits and Systems 1995, Singapore, 1995, 1-4.

SUCHER, R., An adaptive nonlinear filter for detection and removal of impulses, Proc. IEEE Workshop on Nonlinear Signal and Image Processing 1995, Vol. II, 607-610.

WEINRICHTER, H., PUSCH, W., FRIMPONG, G.K., Gleichstromfreie fehlerkorrigierende Codes, Vorträge der ITG-Fachtagung, ITG-Fachbericht 130, "Codierung für Quelle, Kanal und Übertragung", München, Okt. 1994, 449-456.

WESS, B., Optimizing signal flow graph compilers for digital signal processors, Proc. Internat. Conf. on Signal Processing Applications and Technology, ICSPAT'94, Dallas, Texas, Okt. 1994, 665-670.

WESS, B., Code generation based on Trellis diagrams, in: Marwedel, P., and Goossens, G., eds., *Code generation for embedded processors*, Kluwer Academic Publishers, 1995, pp. 188-202.

WESS, B., KREUZER, W., Optimized DSP assembly code generation starting from homogeneous atomic data flow graphs, Proc. MWSCAS'95, Rio de Janeiro, Aug. 1995.

WURZER, M., FELDER, A., POPP, J., BÖCK, J., 20 Gb/s silicon bipolar XOR gate for optical transmission systems, Proc. 21st Europ. Conf. on Opt. Comm., ECOC'95, Brüssel, Sept. 1995, 1035-1038.