Principal Investigator: Zhou, G. Tong .
Organization: GA Tech Res Corp - GIT
Title:
CAREER: A Research, Education, and Technology Transfer Proposal in Statistical Signal Processing with Emphasis on Nonlinear System Identification

Project Participants

Senior Personnel

  Name: Zhou, G. Tong
  Worked for more than 160 Hours: Yes
  Contribution to Project:

Post-doc

  Name: Kim, Yongsub
  Worked for more than 160 Hours: Yes
  Contribution to Project: GRA, conducted research and wrote papers.

  Name: Yang, Lei
  Worked for more than 160 Hours: Yes
  Contribution to Project: GRA, performed research.

  Name: Nagarajan, Krishnamurthy
  Worked for more than 160 Hours: Yes
  Contribution to Project: GRA, conducted research and wrote papers.

  Name: Redfern, Arthur
  Worked for more than 160 Hours: No
  Contribution to Project: Completed a PhD dissertation on nonlinear communication channel equalization. Contributed to this project but was supported mainly by another fellowship.

  Name: Craven, Stephen
  Worked for more than 160 Hours: No
  Contribution to Project: Learned statistical signal processing theory, spectral regrowth in (nonlinear) power amplifiers and predistortion methods.

  Name: Chen, Ning
  Worked for more than 160 Hours: Yes
  Contribution to Project:

  Name: Qian, Hua
  Worked for more than 160 Hours: Yes
  Contribution to Project:
Other Collaborators or Contacts

Prof. Ronald Schafer at Georgia Tech.
Prof. Georgios B. Giannakis at the University of Minnesota.
Prof. Mats Viberg at the Chalmers University of Technology.
Prof. Tomas McKelvey at the Chalmers University of Technology.

Activities and Findings

Research and Education Activities:
1. Volterra nonlinear channel equalization (single or multiple user, time-invariant or time-varying)
2. Analysis of spectral regrowth of nonlinear power amplifiers
3. Predistortion linearization of power amplifiers for communications applications
4. Harmonic retrieval in the presence of nonstationary noise
5. Polynomial phase signal modeling of nonstationary processes
6. Network traffic analysis and resource allocation
7. Biological point process modeling
8. Communications channel estimation and equalization

Findings:
1. Developed methods to compensate for severely nonlinear systems.
2. Proposed a formula for predicting spectral regrowth of nonlinear power amplifiers, helpful for verifying transmission signal spectrum compliance.
3. Developed an algorithm to estimate the frequency of a harmonic embedded in nonstationary noise.
4. Developed an iterative procedure to estimate the parameters of...
5. Constructed a fractional ARIMA model to account for long and short memories present in the variable bit rate (VBR) video streams.
6. Developed a new algorithm to efficiently allocate network resources (bandwidth and buffer size) to different type of sources.
7. Implemented an algorithm that tracks and subsequently equalizes time-selective fading channels.
8. Devised a point process model to interpret neuro-biological data.
9. Developed a 'hidden pilot' method for communications channel estimation.

These findings are reported in journal and conference papers (see the publications section).

Training and Development:
Students learned how to search the literature for relevant papers, devise new algorithms, write conference and journal papers, and give group and conference presentations. Four PhD students have graduated; one of them (Arthur Redfem) won a Georgia Tech research award.

Outreach Activities:
1. Developed a Java-based virtual laboratory on 'Random Signals'. These Java applets are included in the NEEDS (National Engineering Education Delivery System) and the World Lecture Hall databases. They are being translated into the Bahasa Malaysian language and used in a 'Cognitive Sciences and Human Development' research project at the Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia and the University of Otago, New Zealand.
2. Supervised research of female undergraduate students (Gail Rosen, Thao Tran).

Journal Publications


### Books or Other One-time Publications


Editor(s): John Webster

Collection: Encyclopedia of Electrical and Electronics Engineering, John Wiley & Sons
Bibliography: vol. 20, pp. 492-509


Collection: Proc. 4th IEEE International Conference on Signal Processing, Beijing, China
Bibliography: pp. 164-167


Bibliography: pp. 1585-1588


Collection: Proc. American Society for Engineering Education Annual Conference, Charlotte, NC
Bibliography: Session 3232, pp. 1-8.


Collection: Proc. Workshop on Heavy Tailed Distributions, Washington, DC
Bibliography: CDROM


Collection: Proc. 33rd Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA
Bibliography: pp. 986-990


Bibliography: pp. 529-533


Collection: Proc. 33rd Asilomar Conference on Signals, Systems, and Computers, Pacific Grove, CA
Bibliography: pp. 248-251


Bibliography: pp. 2609-2612


Collection: Proc. 34th Asilomar Conference on Signals, Systems, and Computers
Bibliography: pp. 842-846
Bibliography: pp. 2673-2676

Collection: Proc. 57th Automatic RF Techniques Group Conference
Bibliography: pp. 54-70

Collection: Proc. 8th Intl. Symposium on Microwave and Optical Technology
Bibliography: pp. 189-193

Collection: Proc. 11th IEEE Statistical Signal Processing Workshop
Bibliography: pp. 74-77

Collection: Proc. 35th Asilomar Conference on Signals, Systems, and Computers
Bibliography: pp. 653-657

Bibliography: vol. 3, pp. 2689-2692

Collection: Adaptive predistortion linearization of RF power amplifiers using lookup tables generated from subsampled data
Bibliography: pp. 233-236

Collection: Proc. 10th IEEE DSP Workshop
Bibliography: to appear

Collection: Proc. 10th IEEE DSP Workshop
Bibliography: to appear

Editor(s): to appear
Collection: Proc. 10th IEEE DSP Workshop
Bibliography: to appear

Collection: Proc. 10th IEEE DSP Workshop
Bibliography: to appear

learning architecture", (2002). Conference Proceedings, Accepted
Collection: Memory polynomial predistorter based on the indirect learning architecture
Bibliography: to appear

Web/Internet Site

URL(s):
http://users.ece.gatech.edu/~gtz/java
Description:
This site contains a Java-based "Random Signals and Noise" virtual laboratory, which implements the education component of the proposal.

Other Specific Products

Product Type: Teaching aids
Product Description:
Developed a course packet for a graduate level course 'Theory and Applications of Higher-Order and Cyclic Statistics in Signal Processing'. Taught the course both at Georgia Tech and at the Chalmers University of Technology, Sweden.
Sharing Information:
The course packet was made available by the Georgia Tech bookstore.

Contributions

Contributions within Discipline:
Currently, most statistical signal processing research is about linear, stationary, Gaussian processes, which is a simplification of real life data. We have investigated nonlinear, nonstationary, and/or non-Gaussian processes. This is a more challenging task but is closer to reality. Our work on adaptive predistortion of nonlinear power amplifiers has direct impact on increasing the efficiency of power amplifiers used in communications applications.

Contributions to Other Disciplines:
Some research projects are inter-disciplinary. For example, our work on biological point process modeling was the result of collaborative efforts with neuro-biologists. Our work on predistortion linearization of power amplifiers is based on collaboration with RF/microwave researchers. The Java applets on 'Random Signals' can be utilized by almost all science and engineering disciplines. They already are used in other countries (such as Malaysia).

Contributions to Human Resource Development:
PhDs graduated:
Arthur Redfern, PhD 1999. Current position: Member of the Technical Staff, Communications Systems Laboratory, Texas Instruments DSP R&D Center, Dallas, TX.
Yongsub Kim, PhD 2000. Current position: Director R&D, Danam USA, Inc. San Jose, CA.
Muhammad Ikram, PhD 2001. Current position: Member of the Technical Staff, DSPS R&D Center, Texas Instruments, Dallas, TX.

Contributions to Resources for Research and Education:
Jointly with Prof. Schafers lab at UCSD - Biology, we have developed an image processing and automatic tracking system that is capable of monitoring animal behavior under the microscope for long periods of time.

Contributions Beyond Science and Engineering:

Categories for which nothing is reported:
Contributions: To Any Beyond Science and Engineering