

# Boğaziçi University

Telecommunications and Signal Processing  
Research Areas

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- **Communications**
- **Speech Processing**
- **Signal Processing**
- **Image and Video Processing**
- **3D Data Analysis**
- **Biomedical Applications**

# Telecommunications and Signal Processing Group Members

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- **Prof. Dr. Emin Anarım**
- **Prof. Dr. Levent Arslan**
- **Prof. Dr. Hakan Deliç**
- **Prof. Dr. Ayşın Ertüzün**
- **Asst. Prof. Kerem Harmancı**
- **Asst. Prof. Mutlu Koca**
- **Asst. Prof. Burak Acar**
- **Asst. Prof. Jıvanç Mihçak**
- **Prof. Dr. Bülent Sankur**
- **Asst. Prof. Murat Saraçlar**

# Communications

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- Ultra Wideband (UWB) Communications
- Multiuser and MIMO Communications
- Advanced Coding and Modulation for Broadband Communications
- Space-Time-Frequency Signal Processing for Communications

# Communications

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- Turbo Signal Processing for Communications
- User Cooperative Diversity
- Low-Power Low-Complexity Transceiver Design
- Sensor Networks

# Speech Processing

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- **Voice Conversion**

- Applications in film dubbing, film looping

- **Turkish Dictation System**

- Must handle vocabulary explosion and the complexity of the N-gram language of an agglutinative language like Turkish.

# Speech Processing

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- **Turkish Broadcast News Transcription and Retrieval**
  - Making archives of news broadcasts searchable and browsable
  - Use large vocabulary continuous speech recognition and efficient indexing with weighted finite state automata.
- **Speech Driven 3-D Face Synthesis**
  - Visual speech animation from an input speech to drive an MPEG-4 facial engine.

# Signal Processing for Security



## ■ Steganalysis and Watermarking

- Automatic detection of hidden messages in media
- Insertion of signatures in multimedia documents
- Fingerprinting and traitor tracing

## ■ Hash functions

- Extracting robust signatures from media content
- Use of hash functions for content authentication and verification

# Signal Processing for Security

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- **Intrusion Detection Systems (IDS)**
  - Analysis of network traffic and content data
  - Detect anomalous network activity and potential misuse.
- **Cryptanalysis**
  - State-of-the-art encryption and multimedia protection techniques



# Signal Processing for Communications

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## ■ **Adaptive Filters**

- Development of novel algorithms for impulsive communication channels

## ■ **Adaptive Acoustic Echo Cancellation**

- To mitigate echos and to achieve the quality standards in ITU-T:G.167.

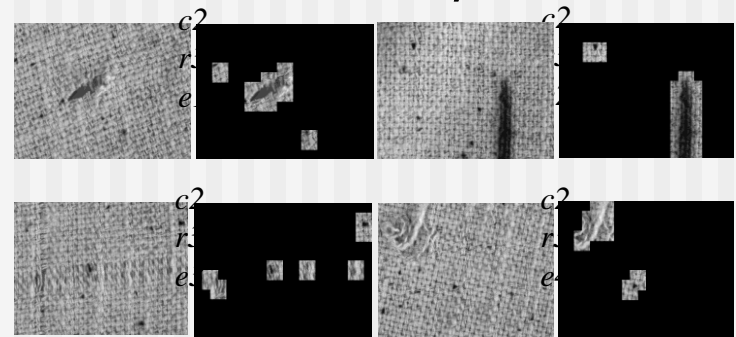
# Signal Processing Applications

## ■ Bayesian Techniques

- Sequential Monte Carlo methods to model *time-varying* autoregressive impulsive signals.

## ■ Source separation methods

- Echo cancellation, astrophysical source separation, texture defect detection, SAR images



## ■ Image Denoising

- Use of multiwavelets to eliminate noise in images

# Image and Video Processing

- **Video object tracking**

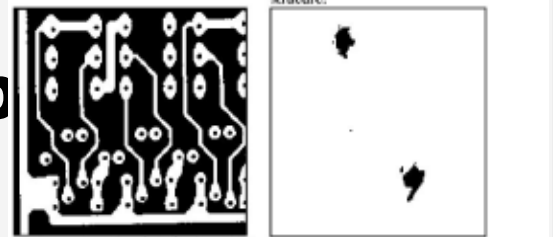


- Scalable object-tracking framework for non-rigid video objects.

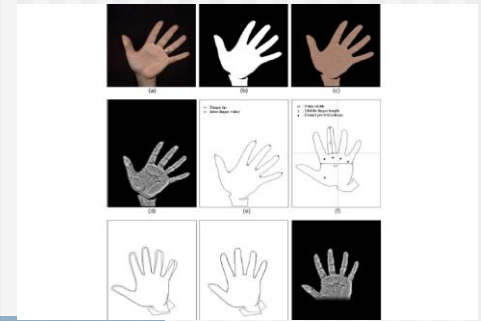
- **Image and Video Quality**

- Objective measures of video compression and segmented object quality.

- **Automated quality insp**



# Biometry



## Security and Man-Machine Interface Applications

- 2D Face Detection in Cluttered Scenes
- 2D Multi-pose Face Recognition
- Facial Landmark Detection and Tracking
- 3D Face Recognition
- Face Expression Understanding
- Hand-based Biometry for Access Control



# 3D Data Analysis

- **3D Archeological/Cultural Object Indexing**
- Novel modeling, registration, feature extraction, data fusion, and classification methods
- **Computer Aided Detection of Colonic Polyps in Virtual Colonoscopy**

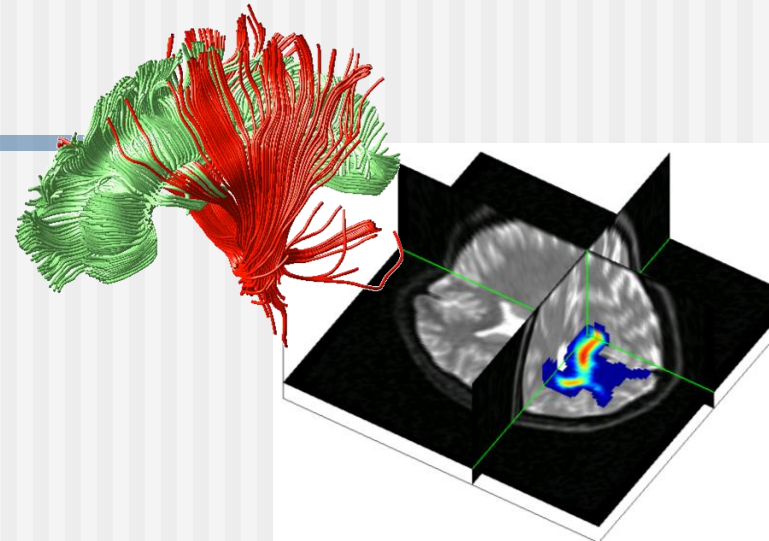


Colonic protruding structures on the colon wall, which is a very flexible tissue with lots of non-polyp bumps and structures.

# 3D Data Analysis

## ■ Human Brain Diffusion Tensor Image Analysis

- To generate an overall connectivity map of the human brain.



Stereo camera



## Flexible, Multi-Dimensional Medical Data Analysis and Visualization Platform Development

We are developing a software platform built that will give even the non-technical people (like MDs) a flexible environment

# Biomedical Signal Processing

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- The Biomedical Signal Processing Group is in collaboration with the [Institute of Biomedical Engineering](#). Main research activities:
  - *Functional near infrared spectroscopy (fNIRS) brain research*
  - *Lung acoustic analysis for diagnostics and instrumentation.*

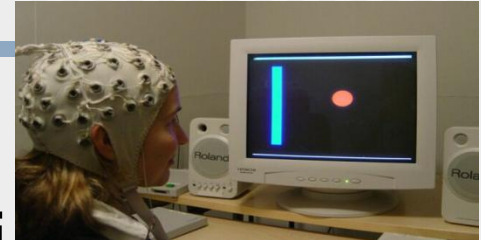
# Biomedical Signal Processing

## ■ **fNIRS Group**

- Developing tools for brain-computer interface.
- Monitoring cognitive and emotional responses of the brain

## ■ **Lung Acoustics Group**

- Developing computerized stethoscopes
- Automated classification and diagnostic of respiratory sounds





# Burak Acar

- *Assistant Professor:*  
B.S., M.S. and Ph.D.  
in EE, Bilkent  
University, Post-doc  
in Stanford University
- *Research interests:*  
Signal and 2D/3D  
Image Processing  
with emphasis on  
medical applications



# Emin Anarım

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- *Professor:* B.S., M.S. and Ph.D. in EE, Boğaziçi University
- *Research interests:* Image Compression and Modeling, Digital Spectral Analysis, Software quality assurance and CMMI, Cryptology and Network Security, Information Warfare, Mobile Networks.



# Levent Arslan

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- *Professor*: B.S. in EE, Boğaziçi University, M.S. and Ph.D. in EE Duke University
- *Research interests*: Signal Processing, Speech Recognition, Synthesis, Enhancement. Voice Conversion



# Ayşın Baytan Ertüzün

- *Professor:* B.S. in EE, Boğaziçi University, M. Eng. in ECE, McMaster University, Canada, Ph.D. in EE, Boğaziçi University.
- *Research interests:* Adaptive and blind signal processing, statistical signal processing and Bayesian techniques, 2-D lattice filters, pattern recognition.



# Mutlu Koca

- *Assistant Professor:*  
B.S. in EE/Physics,  
Boğaziçi University,  
M.S. and Ph.D. in EE,  
UC Davis
- *Research interests:*  
Communication  
theory, Information  
theory and Signal  
processing for  
communications



# M. Kıvanç Mihçak

- *Assistant Professor:*  
B.S. in EE, Bilkent University, M.S. and Ph.D. in ECE, University of Illinois, Urbana-Champaign.
- *Research interests:*  
Multimedia security (watermarking, fingerprinting, hashing), image and video processing (compression, denoising), information theory, detection-estimation theory



# Bülent Sankur

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- *Professor*: B.S. in EE, Robert College, M.S. and Ph.D. in EE, Rensselaer Polytechnic Institute, NY, USA.
- *Research interests*: Image and video processing, signal processing for security, biometric applications, man-machine interfaces.



# Murat Saraçlar

- *Assistant Professor*; B.S. in EE, Bilkent University M.S. and Ph.D. in ECE, Johns Hopkins University, Baltimore.
- *Research interests*: Speech Processing, Automatic Speech Recognition, Natural Language Processing, Machine Learning

