

Smart Sampling (Xampling) Workshop

Department of Electrical Engineering

Technion

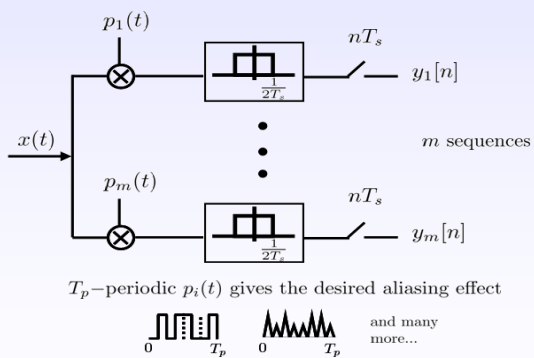
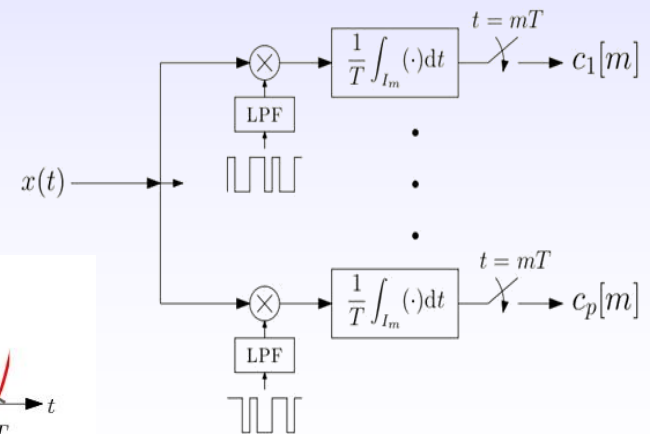
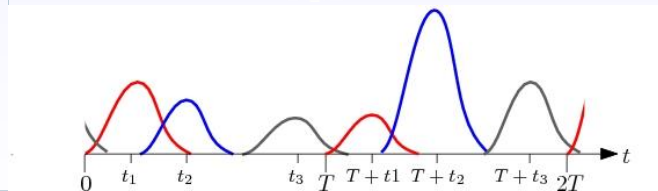


Figure 2. The modulated wideband converter



Xampling Lab

■ Research Group:

M.Sc.



Reuven
Berkun



Omer
Bar-Ilan



Deborah
Cohen



Tanya
Chernyakova



Noam
Wagner

Ph.D.



Tomer
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Yoav
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Post Docs



Malisha
Marijan



Winston
Ho

Xampling Lab

- Former students who worked on Xampling:



Zvika Ben-Haim Tsvika Dvorkind Kfir Gedalyahu Sivan Gleichman Ronen Tur Ewa Matusiak Moshe Mishali

- Algorithm and application development



The Signal and Image Processing Lab



The Vision and Image Sciences Lab

HSDSL Staff & Xampling lab



Mony Orbach
Lab Engineer



Eli Shoshan
System architecture
Cluster coordinator



Ina Rivkin
Application Engineer



Beruria Zohar
Lab Technician



Idan Shmuel
System Engineer



Rolf Hilgendorf
Research Engineer



Academic supervisor
Professor Tsahi Birk

High Speed Digital System Laboratory HSDSL

Research and Educational Activities

System architectures in varied areas - design & implementation

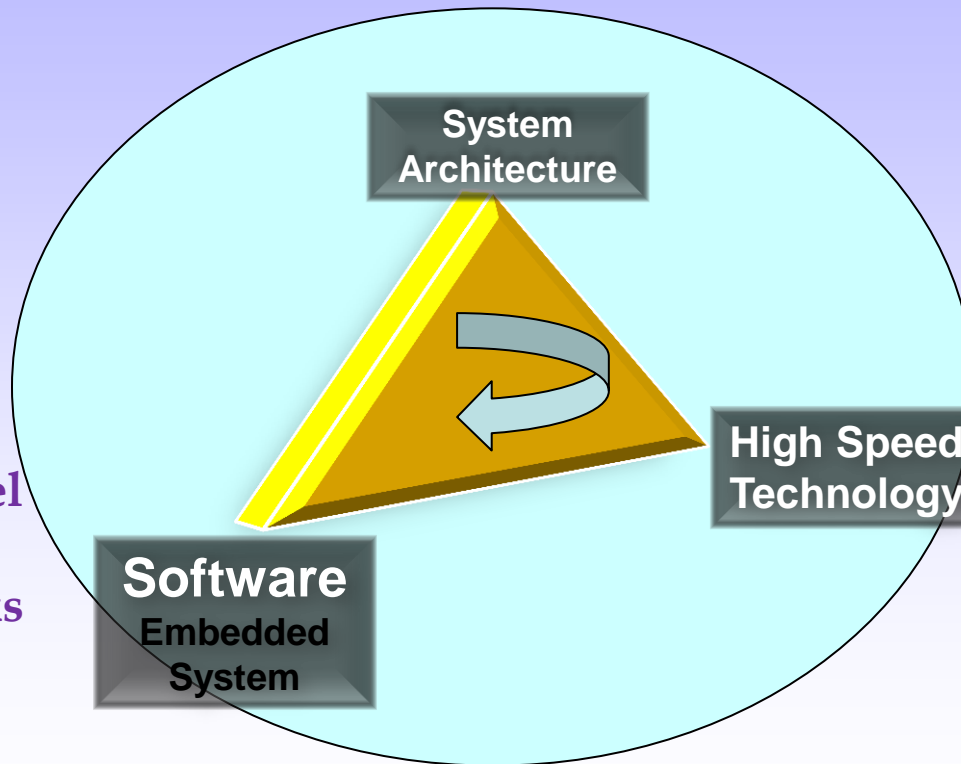
Real time Image
processing

Communication

Navigation

High speed channel

Computer networks



Real time signal
processing

Medical systems

Encryption

Many core systems

Reliable systems
space technology



HSDSL Scope

Departmental center of expertise for:

- Hardware design
- PCB design
- High speed design
- High performance hardware–centric systems architecture

Complex systems projects that really work!

- Design
- Implementation
- Integration
- Testing

Running five lab experiments (500 students yearly)

Total of 50 projects yearly (100 students)

An important pillar of the EE and CE tracks

Collaborators

- Prof. Moti Segev and Prof. Oren Cohen from the Physics department
Dr. Eli Osherovich, Prof. Alexander Szameit, Yoav Shechtman, Pavel Sidorenko, Snir Gazit, Maor Mutzafi
- Prof. Andrea Goldsmith from Stanford
- Prof. Danijela Cabric from UCLA
- Prof. Boris Murmann from Stanford
- Prof. Calderbank from Duke
- Prof. Anna Scaglione from UC Davis
- Prof. Guillermo Sapiro from University of Minnesota
- Prof. Mike Davies from University of Edinburgh
- Prof. Emmanuel Candes from Stanford
- Prof. Ted Rappaport from Polytechnic Institute of NYU
- Prof. Joe Goodman and Jeff Wilde from Stanford

- Many industrial partners, some of which you will hear later today

Agenda

8:30-9:00	Registration and refreshments
11:00-11:20	<u>Sub-Nyquist Sampling of Wideband Signals</u>
13:15-13:25	<u>The EE Department and Industry - Collaboration Mechanisms</u>
9:00-9:10	Prof. Yitzhak (Tsahi) Birk
11:20-11:40	<u>Welcome</u>
13:25-13:45	<u>EE Department, Technion</u>
9:10-9:20	Prof. Adam Schwartz
11:40-12:00	<u>Compressed Beamforming in Ultrasound Imaging</u>
13:45-14:05	<u>Test and Measurement for Sub-Nyquist Sampling</u>
9:20-9:30	Noam Wagner
11:20-11:40	<u>The Smart Sampling Lab @ HSDSL</u>
13:45-14:05	<u>EE Department, Technion</u>
9:30-9:40	James Kimery
11:40-12:00	<u>Nonlinear Sampling with Application to Imaging</u>
13:45-14:05	<u>EE Department, Technion</u>
9:40-9:50	Director of Marketing RF / Communications/ISDR
11:40-12:00	<u>Tomer Michaeli</u>
13:45-14:05	<u>Wideband Front End: An Automotive-Mobile Wireless Device Perspective</u>
9:50-10:00	EE Department, Technion
12:00-12:30	<u>Prof. Yonina Eldar</u>
13:45-14:05	<u>Live Demonstration: Real-Time Sub-Nyquist Wideband Sensing</u>
10:00-10:10	EE Department, Technion
12:00-12:30	Rolf Hilgendorf
14:05-14:25	<u>Simulation Platform for Signal Processing and Analysis of UWB Radar and Multi Fading Channels</u>
10:10-10:20	EE Department, Technion
14:05-14:25	<u>Prof. Moti Segev</u>
10:20-10:30	Haim Spiegel
12:30-13:15	<u>Physics Department and Solid State Institute, Technion</u>
10:30-10:40	Agilent Technologies
12:30-13:15	Light Lunch
10:45-11:00	Coffee Break

Xampling: Low-Rate Sampling

Sample only the info that is needed

Xampling = Compression+Sampling

- Speed – faster systems
- Scale – smaller systems
- Cost – reduce system cost
- DSP – reduce DSP processing as well
- Break technology limit

Beyond sampling rate ...

- Resolution: trade off rate for resolution
- Dynamic range: trade off rate for bits
- Noise robustness: trade off rate for robustness
- New hardware paradigms even for high rate sampling

Motivation for Applied Research Center

- State of the art A/D converters are based on Shannon theory
- In the past there has been a lot of research into alternative sampling structures such as systems based on wavelets, Gabor windows etc.
- Very little impact on industrial A/D designs
- Today we will consider new theories for sub-Nyquist sampling
- We would like these ideas to impact technology

**Key to Impact: Continue to develop new theory
combined with hardware design
and industry involvement**

Our Vision

- Establish a center of information in smart ADCs
- Including mathematical aspects, digital algorithms, and hardware designs
- Learn about the practical limitations and needs and integrate them into theory
- Apply ideas to various applications: Communications, defense, medical imaging, optics
- High impact in industry by involving industry partners in development and by licensing IP

Paradigm Shift That Can be Game Changing in
Industry

Thanks

- Research students and HSDSL staff
 - Yoram Shabtai
 - Yankee Yavor
 - Yoram Or-Chen
 - Yaffa Levi
 - Sasha Azimov
-
- Special Thanks: Suzie Eid, Ina Rivkin, Eli Shoshan