Samuele Martelli, PhD
Istituto Italiano di Tecnologia, Genoa, Italy
<table>
<thead>
<tr>
<th>International Joint Labs</th>
<th>10 Centers close to National Universities and Institutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvard University (USA): Neurobiology</td>
<td>- IIT Governance, Evaluation, Staff and Labs</td>
</tr>
<tr>
<td>MIT (USA): Computational Machine Learning</td>
<td>- Invest for 5 years</td>
</tr>
<tr>
<td></td>
<td>- Sinergy with hosted institutes</td>
</tr>
</tbody>
</table>

- Genova Central Research Lab
  - Advanced Robotics
  - Drug Discovery and Development
  - iCub Facility
  - Nanochemistry
  - Nanophysics
  - Nanostructures
  - Neuroscience and Brain Technologies
  - Pattern Analysis & Computer Vision
  - Robotics, Brain and Cognitive Sciences

- Research Centers
  - Center for Space Human Robotics
  - Center for Nano Science and Technology
  - Center for Genomic Science
  - Center for Neuroscience and Cognitive Systems
  - Brain Center for Motor and Social Cognition
  - Center for Nanotechnology Innovation
  - Center for Micro-Biorobotics
  - Center for Life Nano Science
  - Center for Advanced Biomaterials for Health Care
  - Center for Biomolecular Nanotechnologies

- Centers close to National Universities and Institutes:
  - IIT Governance, Evaluation, Staff and Labs
  - Invest for 5 years
  - Sinergy with hosted institutes
Can we do better? ...
Seeing what humans cannot see ...
DualCam output

Off-the-shelf videosurveillance video stream overlayed with the acoustic image, generated by the onboard processor
Delay & Sum Beamforming

Image courtesy of ©GfaI
Acoustic Camera

Delay & Sum – Beamforming:

microphone - array with M sensors $i = 1 \ldots M$

virtual measurement plane

measurement object

actual image section (Pixel) for the location $x$

different distances $|r_i|$ between sensor No. $i$ and location $x$ lead to various absolute run times $r_i = |r_i| / c$

Image courtesy of ©GfaI
Rilevamento eventi anomali: es. spari
Monitoraggio del traffico
Microfono virtuale
Tracking di parlante
DRONE SURVIVAL GUIDE

Company
Purpose
Problem
Solution
Why
Now
Market Size
Competition
Product
Business Model
Team
Financial
OUR SOLUTION
First Prototype – 2011/12

DUALCAM
sound and light imaging

150 cm

PATENT PENDING
Drone Tracking
Drone Detection and Tracking
Microphones : 128 Digital MEMS TDM
On-Board PC : DualCore ARM + FPGA
Communication: Ethernet, USB, Serial Port
Output Video : VGA, HDMI
User Controls: Keyboard, mouse, touchpad
Power : 12V-DC

Mic PCB Size : 450 mm x 450 mm
Mic PCB thickness : 1.6 mm
Mic Sampling Frequency : 12.8K Hz
Sampling Resolution : 24 bit

“Metodo Per La Configurazione Di Disposizioni Planari Di Trasduttori Per L’elaborazione Di Segnali A Banda Larga Mediante Beamforming Tridimensionale E Sistemi Di Elaborazione Di Segnali Che Utilizzano Tale Metodo, In Particolare Telecamera Acustica”
Marco CROCCO, Vittorio MURINO, Andrea TRUCCO


“Metodo Di Tracciamento Di Una Sorgente Acustica Bersaglio”
Marco CROCCO, Samuele MARTELLI, Vittorio MURINO, Andrea TRUCCO
Experimental Scenario
Experimental Scenario

200 m
Experimental Scenario

200 m
Video: Drone Detection and Tracking

Min. Frequency: 1500 Hz
Max Value: 0.001741567360
Video: Drone Detection and Tracking

Min. Frequency : 1500 Hz
Max Value : 0067919495168
Video: 2 UAVs
Video: 1 UAV + 1 CAR

Min. Frequency : 1500 Hz
Max Value : 0042328760320

Speed 2X
## Detection and Neutralisation Systems

<table>
<thead>
<tr>
<th></th>
<th>Anti-UAV Defence System (AUDS)</th>
<th>Falcon Shield / Selex ES</th>
<th>DRONE DOME</th>
<th>IHTAR/ASELSAN</th>
<th>THALES Geckos System</th>
</tr>
</thead>
<tbody>
<tr>
<td>(United Kingdom)</td>
<td>(United Kingdom - Italy)</td>
<td></td>
<td>Israel</td>
<td>Turkey</td>
<td>France/Spain</td>
</tr>
</tbody>
</table>

### Detection Systems/Sensors

<table>
<thead>
<tr>
<th></th>
<th>Elvira Robin Radar</th>
<th>Gamekeeper 16U AVEILLANT</th>
<th>Giraffe AMBs SAAB</th>
<th>Drone Detector AARONIA</th>
<th>Drone Tracker Dedrone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radar and PTZ Camera</td>
<td>Holographic 3D Radar</td>
<td>Agile Multi Beam (AMB) Radar</td>
<td>RF Radar Antenna 9KHz – 20GHz</td>
<td>Audio Single Microphone</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Drone Tracker RF Sensor/ Dedrone</th>
<th>Drone Shield</th>
<th>Drone Detector/ Orelia</th>
<th>Drone Detector / MAGNA</th>
<th>DUAL CAM sound and light imaging</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radio Frequency Passive Antenna</td>
<td>Audio Single Microphone</td>
<td>Audio single microphone</td>
<td>Sound, video and thermal cameras</td>
<td></td>
</tr>
</tbody>
</table>
Competitors

- **Drone Detector**
  - Orelia (France)

- **Drone Shield**
  - (USA)

- **Drone Tracker**
  - (Germany-USA)

Main Limitation: Short Range (< 100m)
Founders

Co-Founder, R&D
Ing. Marco Crocco, PhD

Founder, CEO
Ing. Samuele Martelli, PhD

Co-Founder, CTO
Ing. Pietro Salvagnini, PhD

Electronic Design Lab
Scientific Committee

Prof. Vittorio Murino
Co-Founder
Scientific Advisor
Computer Vision

Prof. Andrea Trucco
Co-Founder
Scientific Advisor
Acoustic Signal Proces.

Prof. Massimiliano Pontil
Scientific Advisor
Machine Learning
External Advisors

Ing. Enrico Franceschi
Product Development

Ing. Luigi Portaluri
Business Development

Ing. Paolo Pettenelllo
Business Management
- Pres. DANONE (Sud-Europa)
- AD GFC S.p.A.
- DG MONTEBOVI S.p.A.
Innovazione cercasi
Grandi aziende a caccia di grandi idee.

SCOPRI DI PIÙ
Acknowledgements:

Carlos Beltran, Bruno Bonino, Matteo Bustreo, Francesco Diotalevi, Angelo Illarcio, Claudio Lorini, Giulio Sandini, Andrea Trevisani, & Andrea Zunino.
Grazie