Uncooled Infrared Imaging Technology & Market Trends 2014

Commercial & Military Applications

- Opgal
- FLIR
- Sofradir EC
- Heimann/Bosch
- FLIR
- BAE
- Fluke
Definitions

- An infrared thermal camera is a thermal system which converts infrared (IR) radiation into a visible image.
- An IR camera’s main parts are:
  - **Camera**
  - **Camera core (with electronics and sometimes IR lenses)**
  - **Imager/sensor (Uncooled Focal Plane Array - UFPA)**
  - **Pixel (Each sensor is an array of thousands of pixels)**

- **Cores** are modules that include imagers + electronics, and sometimes lenses. Without lenses, it’s also called a “video engine”.
- **Imagers** are also called UFPA (Uncooled Focal Plane Arrays) or IR sensors. Detectors provide only a detection signal (no image) and are covered in Yole’s 2013 report on the IR detector market and technology trends.
- An imager can have various formats (1024 x 768 to 16 x 16) and pixel pitch (usually from 17µ - 40µ in 2013).
Market Research Scope and Methodology (1/2)

• **Market research scope:**
  – This report surveys the Long Wave Infrared (called LWIR or FIR) uncooled imaging camera and imager markets for both commercial and military businesses.
  – An overview of Near Infrared (NIR), Short Wave Infrared (SWIR) and Medium Wave Infrared (MWIR) technologies is also presented here.
  – Market forecasts are furnished for the 2014 – 2019 period in shipments (units) and in revenue ($M).
  – For an in-depth analysis of IR detector applications & technologies (from 1 – 100 x 100 pixels), see Yole’s “Infrared Detector Market 2013 Report”.

• **Methodology:**
  – Our research is based on:
    • Primary information sources: direct interviews with companies across the value chain (imager manufacturers, camera manufacturers, camera distributors and end-users).
    • Secondary information sources: conferences, web sites, newsletters, etc.
  – All data, graphs, tables and calculations in this report are based on Yole Développement’s investigation.
Market Research Scope and Methodology (2/2)

Yole Développement – July 2014

Price

$1000

$100

$10

$1

Resolution

4x4  8x8  16x16  32x32  64x64  80x80  160x120

Infrared Detectors Report

Uncooled Thermal Imaging Report
2013 Report Changes
New content compared to the 2013 version

- Synthesis of Merge & acquisitions during the last 4 years
- News and analysis of the industry’s latest market entrants and exits.
- Analysis of the new ultra low end cores offers
- In-depth analysis of Thermography, Automotive, Surveillance, FireFighting, Smartphones.
- Addition of a new IR sensor segment (ultra low-resolution microbolometers) into imager market forecast.
- Addition of an optimistic forecast scenario for IR sensors based on smartphones fast development.
- Addition of 3 thermal sensors manufacturer in the forecast: i3 system (KR), Dali (CN), Magnity (CN)
- Identification of current technological trends and ongoing developments: addition of cores electronics trends.
Uncooled thermal imaging
Market forecasts at camera level

Uncooled Thermal Cameras
Market forecast in revenue ($M)

- In 2013, the Thermal Camera market experienced the second year a downturn but with a lower rate (-5%) mainly because of the Military market’s contraction (-15%). Revenue recovery will start slightly in 2014, % and will strengthen until 2015.
- CAGR 2014 - 2019 growth is expected to remain moderate (~1%) due to Military market sluggishness and strong commercial markets price erosion.
- The Uncooled Thermal Camera market will exceed $ 4.5B by 2019, fueled strongly by Surveillance ($: M+), and then Thermography ($: M+), and PVS (M+), compared to 2012.

Uncooled Thermal Cameras
Market forecast in shipments (units):
Optimistic smartphone scenario

- The Uncooled Thermal Camera market is expected to exceed cameras by 2019, fueled by a Smartphone market boom that will exceed units.
- This high market growth will be possible if massive cost reduction happens thanks to the use of new technologies/layer manufacturing infrastructures.
Microbolometer Manufacturers
Market shares evolution

Uncooled Thermal Imagers Manufacturing
2012 & 2013 market share in units

- Ultra low-resolution is widespread in smartphones and ultra low-end thermography market.
- Low end resolution is widespread in low end thermography and fire fighting markets.
- Medium resolution is the most produced imager, thanks its good resolution/price ratio. Affordability results from high-volume manufacturing in Automotive, Thermography and Surveillance.
- High-resolution is very popular in long-range Vision applications such as Military, Marine and Surveillance. These sensors are very expensive. ASP = $1,678 in 2013, which is why high-resolution microbolometers represent the largest revenue share.
Thermography market
Strong battle on ultra low end cameras

Thermography Markets

Predictive maintenance
Building inspection

Other thermography applications: R&D, medical, process control,

Low end cameras price evolution
Price war intensify on ultra low end cameras between FLIR and Fluke

The battle is huge on ultra low end cameras between Fluke and FLIR: FLIR introduce E4 with higher resolution (80x60) below $ 1000 whereas Fluke decrease VT02 pricing by 50% and launched new products with VT04 and then Ti90 and Ti95 => larger price range.
Surveillance Market
Price erosion open new commercial applications

Thermal Surveillance Cameras
Market segmentation

- High-end cameras
  - Long range
    - Large fixed optics
  - More functionalities
    - Medium to high
    - Multiple spectral/thermography
- Short range
  - Small fixed optics
    - 160x120

Thermal Surveillance Cameras
Market forecast in revenue ($M)

- CAGR 2013 - 2018 is ### in revenue.
  - Low end segment (160x120) will reduce due to aggressive pricing on middle end cameras.
  - Growth is driven by middle-end range cameras that represent most of the business due to outdoor, high range distance range and recognition requirements.
Automotive market
A concentrated market
Military market
Missile seekers is confirmed as a high growth rate application

Military Vision Markets

Soldiers
- Thermal Weapon Sight (TWS)
- Portable Vision Enhancement

Vehicles
- Vehicle Vision Enhancers (DVEs and others)
- Remote Weapon Stations (RWS)

Other Military applications
- Unmanned Arial Vehicle (UAV), Unmanned Ground Vehicle (UGV), Unmanned Ground Se (UGS), Missile Seekers.

Missile Seekers (3/3)
Cooled vs. uncooled detectors

Cooled detectors
- High sensitivity → long-distance operation
- Fast frame rate → can follow fast-moving object
- High-resolution

Uncooled detectors
- Low SWAP
- Low complexity & higher reliability → reduced number of parts, low bulkiness
- Long lifetime
- Rapid turn-on time for snap-attacks
- Wide operating temperature range
- Short thermal time constant

- A market exists for both cooled & uncooled detectors in missile seekers. Consequently, these products will be in direct competition in modern IR guided missiles. However, uncooled detectors may be preferred on short-distance missiles used for fixed targets.
New applications
Smartphones & personal vision systems

Smartphone Market Segment (3/5)
- Products:
  - Iphone platform: Flir presented Flir One at CES show in Jan 2014, the first IR camera accessory for Apple Iphone, using a new core, Lepton, with 60 x 60 resolution, 100mK NETD, WLP and VVO included.
  - Android platform: Opal presented the first IR camera accessory for Android smartphones targeting more professional users thanks to high resolution (QVGA) and high price point ($4000).

Personal Vision Systems (PVS) Segment
Overview
- Segment description:
  - Personal vision systems includes both portable binocular or monocular and sight for rifles. Those units are used for border patrol, law enforcement and consumer use, i.e. mountain sports and hunting. With price erosion, this market becomes more and more oriented towards consumers. Introduction of smartphone plug in (Flir One) could compete with those products.

- Market insights:
  - 2013: 36M units
  - 2014-2019 CAGR: 17% units

- Pricing:
  - ASP 2013: 
  - Price ranges from 

- Players:
  - FLIR is the market leader, with a dedicated product line whose 2012 sales jumped to 10,000

- Resolution:
  - mostly 320 x 240, and some VGA (law enforcement).
Technology analysis

New Technologies’ Time-to-Market and Impact on Cost Reduction

Impact on Cost Reduction

- Low-resolution/low-cost sensor technologies
- Pixel pitch reduction
  - 12 microns
  - 6 microns
- Core electronics Integration
  - ASIC
  - ASIC 3D TSV
- Wafer Level techniques
- WLO
- WLP

Microbolometers 12μm pixel pitch trend (6/6)

- BAE has introduced on the market for the first time 12 microns imagers in 2013 to 2014, followed by NEC. (NEC: Introduction in 2020 and 2021)

12μm technology available

12μm technology in development

Time to market sampling
Available MEMS reports

- Technologies & Sensors for the Internet of Things
- MEMS for Cell Phones and Tablets
- Status of the CMOS Image Sensors Industry
- Status of the MEMS Industry
- MEMS Microphones

- Inertial MEMS Manufacturing Trends 2014
- MEMS Pressure Sensor
- MEMS Front-End Manufacturing Trends
- Infrared Detectors Technology & Market Trends
- RF Filters, PAs, Antenna Switches & Tunability for Cellular Handsets

- IMU & Gyro for Defense, Aerospace & Industrial
- Emerging MEMS
- Technology Trends for Inertials MEMS
- Ferro-Electric Thin Films
- Trends in MEMS Manufacturing & Packaging

- Motion Sensors for Consumer & Mobile applications
- Sensor fusion of acceleros, gyros & magnetometers
- Thin Wafer Handling
- MEMS Cosim+ MEMS Manufacturing Cost Simulation Tool

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Our offices and contact information

Japan Office

• For custom research: Yutaka Katano, General Manager, Yole Japan & President, Yole K.K.
  Phone: (81) 362 693 457 - Cell: (81) 80 3440 6466 - Fax: (81) 362 693 448 - Email: katano@yole.fr

• For reports business: Takashi Onozawa, Sales Asia & General Manager, Yole K.K.
  Email: onozawa@yole.fr

European and North America Office

• Yole Développement Headquarter, France: David Jourdan, Sales Coordination & Customer Service, Tel: +33 472 83 01 90, Email: jourdan@yole.fr

Korea Office

• Hailey Yang, Business Development Manager, Phone: (82) 2 2010 883 - Cell: (82) 10 4097 5810 - Fax: (82) 2 2010 8899 – Email: yang@yole.fr
For more information…

Take a look at our websites:

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  - 75 Cours Emile Zola, 69100 Villeurbanne/Lyon - France

### SALES CONTACTS

- **North America:**
  - David Jourdan - jourdan@yole.fr
- **Asia:**
  - Takashi Onozawa - onozawa@yole.fr
- **Europe & RoW:**
  - Jean-Christophe Eloy - eloy@yole.fr
- **Korea:**
  - Hailey Yang - yang@yole.fr
- **General:**
  - info@yole.fr

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### CONTACTS

For more information about:

- Consulting Services: Jean-Christophe Eloy (eloy@yole.fr)
- Financial Services: Géraldine Andrieux-Gustin (andrieux@yole.fr)
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