CONTENT ENGINEERING & VISION LABORATORY

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www.cea.fr
Mission DAM: France’s national **security independence**

Mission DEN: France’s **energy independence**

Mission DRT: French business’ **economic competitiveness**

Human resources: 16,000

10 Research centers

Budget: € 4,7 Bn

4,674 Patent families in portfolio (2012)

701 Priority patents delivered

157 Innovative high-tech start-ups since 1972

53 Joint research units
CEA TECH: A WIDE OFFER OF KEY ENABLING TECHNOLOGIES

**Leti**
Laboratory of Electronics and Information Technologies
Staff: 1600, Budget: €300 M

- Micro-nanotechnologies and their intégration in systems

**LIST**
Laboratory of Integrated Systems and Technologies
Staff: 700, Budget: €90 M

- Software-intensive systems
  - Advanced manufacturing

**Liten**
Laboratory of Innovation for new Technologies for Energy and Nanomaterial
Staff: 1100, Budget: €170 M

- New energy technologies and nanomaterials
Scene Understanding
Detection/tracking and activity analysis

3D Perception & Mobility

Multimedia

Localisation Augmented Reality

Semantic Analysis Text / Image

Laboratoire Vision & Ingénierie des Contenus
Computer Vision & Natural Language Processing

+80 researchers & engineers on projects
+ 15 PhD students

+50 publications / year
+30 active patents
3D Perception & Mobility

Real-time Localisation and Environment perception
• Augmented Reality
• Indoor/outdoor geo-localisation
• Industrial control
RESEARCH ACTIVITIES

- Augmented Reality
- 3D Localisation & Mapping
- 3D Reconstruction
- 3D Control & Manufacturing
- Material Segmentation
- Scene Illumination Analysis
- Diminished Reality
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AUGMENTED REALITY APPLICATIONS

Real Time Visual Registration Technologies

Marketing

Navigation

Training

Industrial maintenance
AUGMENTED REALITY APPLICATIONS: 2 main kinds

Augmented Objects

Augmented Environnements
AR Glasses

Transparent screens

HUD - Towards full windscreen
DIOTA: Industrial Partner For Augmented Reality Applications

Projective AR

AR software solution

AR on tablet
RESEARCH ACTIVITIES

➢ Augmented Reality

➢ **3D** Localization & Mapping

➢ 3D Reconstruction

➢ 3D Control & Manufacturing

➢ Material Segmentation

➢ Scene Illumination Analysis

➢ Diminished Reality
Indoor
- Indoor Guidance
- Mobile Robots
- ...

Outdoor
- Autonomous vehicles
- Pedestrian Guidance
- ...
LOCALIZATION BY MULTI-SENSOR FUSION

**SENSORS**

- **Camera**: mono, stereo, RGB-D
- **GPS**
- **IMU**
- **Odometry**
- **Lidar**
CAR GUIDANCE
Augmented Reality in TRAMWAY

Concept

Realization

Prototype
RESEARCH ACTIVITIES

- Augmented Reality
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- Diminished Reality
3D RECONSTRUCTION

- Low-cost or wearable systems for 3D Scene Modeling

Stereovision
Multicaméras
Sensor fusion
A consumer hardware & software product

1 or n camera/sensors

Carried or Remote

4+ bracelets/anklets

Dedicated to the Virtual Reality market
MODÉLISATION DU VIVANT

Automatic Physiological Parameters measures
RESEARCH ACTIVITIES

- Augmented Reality
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- Diminished Reality
Defects Detection

Measured features: 
→ holes, curved edges…

Automatic CAD Registration

Bin Picking
3D Multispectral Real-Time Vision sensor for Robotics & Industries

- **Fast & Accurate** 3D Vision solution:
  - Up to 4 3D-frames per second
  - Depth resolution up to 0.2 mm @ 40 cm
  - Robustness with reflecting objects

- **Multispectral data**
  - Useful for material identification applications,
  - True Color Numerisation (independent from ambient light)
RESEARCH ACTIVITIES

- Augmented Reality
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**Multispectral cameras** $\rightarrow$ **better material segmentation** in images
RESEARCH ACTIVITIES

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SCENE ILLUMINATION ANALYSIS

Shadows Detection

Robustness to Light Changes

Realism of Scene Augmentations

Specularities Segmentation
RESEARCH ACTIVITIES

➢ Augmented Reality
➢ 3D Localisation & Mapping
➢ 3D Reconstruction
➢ 3D Control & Manufacturing
➢ Material Segmentation
➢ Scene Illumination Analysis
➢ Diminished Reality
Toward a full concept…
Scene Understanding

Videoprotection & Video Assistance
• Infrastructure Security
• Driving assistance
• Smart Home / Smart building / Smart City
Generic algorithms
Various sensors (Visible, IR, IR/Visible, Fish-eye, PTZ…)
Various Contexts (indoor, outdoor, broadcast)
Fixed or Embedded
Challenge KITTI: Automatic 3D Analysis of Vehicles

1. Vehicle detection
2. Type recognition
3. Fine pose estimation
4. 3D location
5. Visibility of parts

CEA APPROACH: DEEP MANTA
- 1st on detection and orientation estimation
- Close to Real time (3 Hz on VGA)
- Accuracy +30% vs Sota, similar to stereo approach
FACE RECOGNITION

REAL TIME FACE DETECTION

FACE VERIFICATION: Examples of match pairs
Deep Learning for Face Recognition (2016)

Face detection & alignment
Deep Multi-Task Multi-Scale Cascaded Neural Network

Feature extraction
- Deep Metric Learning from Tiplet Network

Face Recognition
- **Verification**: is that face of a given person?
- **Retrieval**: similar faces ranked according to learned metric

Authorized access!

Video query

Authorized access!

Image query

This is ...!

face features (1792-dim) projected in 3-D space
SECURITY: VIDEO PROTECTION

Real-time Analytics

Camera Network & 3D Display

Operated in VisionLab

Behaviour Analysis

Perf Evaluation
SAFETY: PEDESTRIAN DETECTION

BLAXTAIR: Embedded Vision System to enhance safety in critical industrial contexts

TECHNOLOGY POSITIONNING

- Robust 2D/3D analysis:
  TP= 99 %, FA= 1/jour
- Learning on specific image database:
  24 000 positives > 1 million negatives
- Real time: 15 Hz (2 cœurs ARM)
- 5 patents
SAFETY:
VISION SYSTEM FOR PEOPLE DETECTION

Robotics

Vehicle & Cobotics

Obstacle Detection
Lidar/IR barrier

People Classification
Blaxtair/IR Video

SICK
AMBIANT LIVING

Sensor fusion
• Camera
• IR detector
• Home sensing

Applications
• Safety
• Security
• Energy
• Comfort
• IHM

Vulnerable people

Activity Recognition

Eating

Setting the table

Platform MobileMii

TV Control

Setting the table

Activity Recognition

Eating
Multimedia

Semantic Analysis of Text, Image, Video
- Extraction
- Synthesis
- Retrieval
EXTRACTION D’INFORMATION : IMAGES
EXTRACTION D’INFORMATION : TEXTES

Cherchons

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Text processing

Opinions

Morphosyntaxique

Extraction de termes

Entités et relations

San Salvador, 19 Apr 89 (ACAN-EFE) — [TEXT] Salvadoran President-elect Alfredo Cristiani condemned the terrorist killing of Attorney General Roberto Garcia Alvarado and accused the Farabundo Martí National Liberation Front (FMLN) of the crime. ... Garcia Alvarado, 59, was killed when a bomb placed by urban guerrillas on his vehicle exploded as it came to a halt at an intersection in downtown San Salvador. ... Vice President-elect Francisco Mario said that when the attorney general’s car stopped at a light on a street in downtown San Salvador, an individual placed a bomb on the roof of the armored vehicle. ...

Defect

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terme simple (la veste)

terme composé (le short)

terme dérivé (la jaquette)

terme construit (la jupe ultra courte)
CEA List/LVIC

70 researchers
15 PhD students

- 3D Perception
  - Augmented Reality
  - 3D Localization

- Scene Understanding
  - Surveillance systems
  - Assistance systems

- Multimedia fusion
  - Information retrieval
  - Synthesis
We are recruiting!

Our lab recruits non permanent researchers & engineers almost throughout whole the year

Main research domains:

- Computer Vision
- Deep Learning
- Sensor Fusion (mainly Vision/IMU)

(Common minimal skill: C++)

Main Contact: lvic-jobs@cea.fr

Other contacts:

- 3D Perception & Mobility: regis.vinciguerra@cea.fr
- Scene Understanding: quoc-cuong.pham@cea.fr
- Multimedia fusion: bertrand.delezoide@cea.fr