



**ODeM:**  
**Optical Data-transmission systEM**  
**for swarm Micro-robots**

Universität Karlsruhe (TH)  
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 (IPR)

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 Responsable: Marc Szymanski

ODeM: Optical Data-transmission systEM for swarm Micro-robots

## Agenda

- Mission
- Hardware Platform
- Software Tools






ODeM: Optical Data-transmission systEM for swarm Micro-robots

AGENDA

- Mission

# I. Mission

ODeM: Optical Data-transmission systEM for swarm Micro-robots

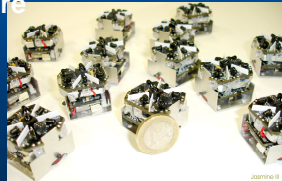
## Projet: Jasmine



AGENDA

- Mission

**Open-Source platform of microrobots:**

- Hardware
- Software





ODeM: Optical Data-transmission systEM for swarm Micro-robots

## Objectives

AGENDA

- Background
- Swarm microrobot
- Projet: Jasmine
- Mission
- Ego-positioning

- 1<sup>er</sup> : Embedded Ego-positioning System
- 2<sup>nd</sup> : Communication with Virtual Pheromones

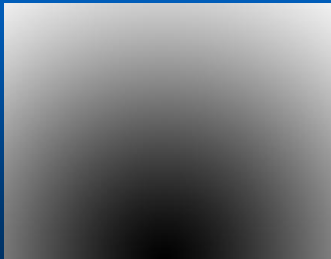





ODeM: Optical Data-transmission systEM for swarm Micro-robots

## Objectives

AGENDA

- Background
- Swarm microrobot
- Projet: Jasmine
- Mission
- Ego-positioning
- Virtual Pheromones



# Objectives

- AGENDA
- Background
    - Swarm microbot
    - Projet. Jasmine
  - Mission
    - Ego-positioning
    - Virtual Pheromones
    - Codes Transmission

- 1er : Embedded Ego-positioning System
- 2nd : Communication with Virtual Pheromones
- 3ème : Codes transmission to the Robots



# III. Hardware Platform

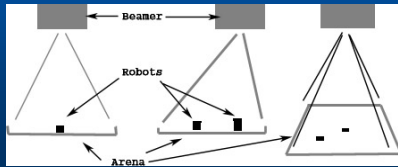
- AGENDA
- Background
    - Swarm microbot
    - Projet. Jasmine
  - Mission
    - Ego-positioning
    - Virtual Pheromones
    - Codes Transmission
  - Hardware



# Description of the System

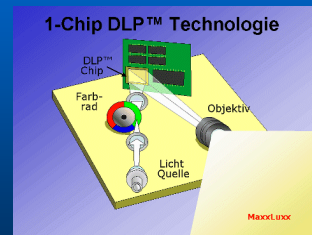
- AGENDA
- Background
    - Swarm microbot
    - Projet. Jasmine
  - Mission
    - Ego-positioning
    - Virtual Pheromones
    - Codes Transmission
  - Hardware

- 1 PC: Image computing
- 1 Beamer: Image projection
- 1 embedded Hardware board



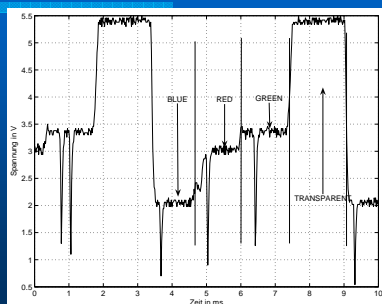
# Beamer: Image projection

- AGENDA
- Background
    - Swarm microbot
    - Projet. Jasmine
  - Mission
    - Ego-positioning
    - Virtual Pheromones
    - Codes Transmission
  - Hardware
    - Beamer



# Beamer: Image projection

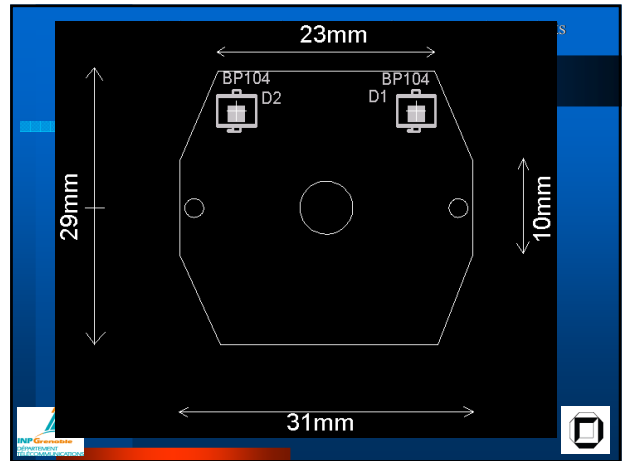
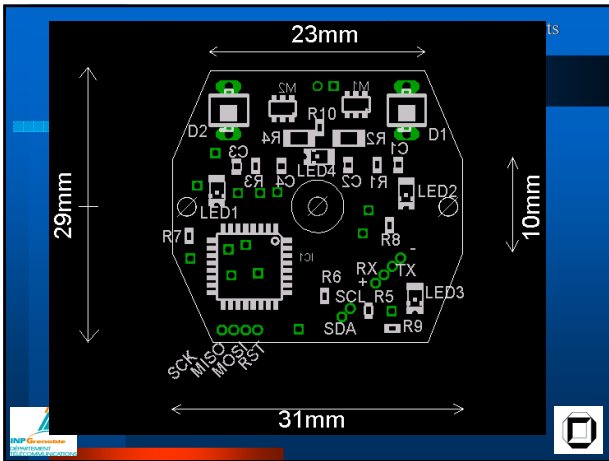
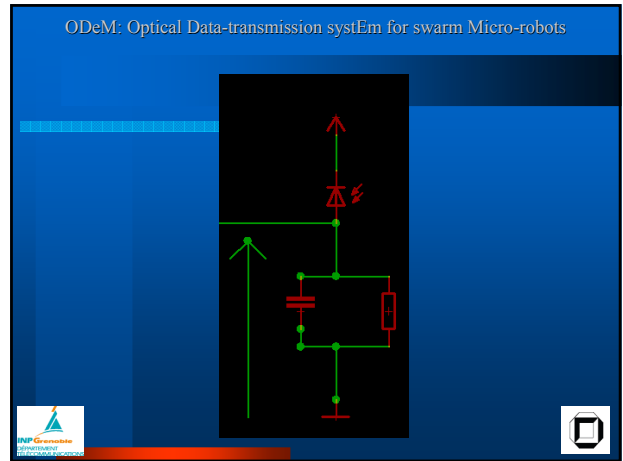
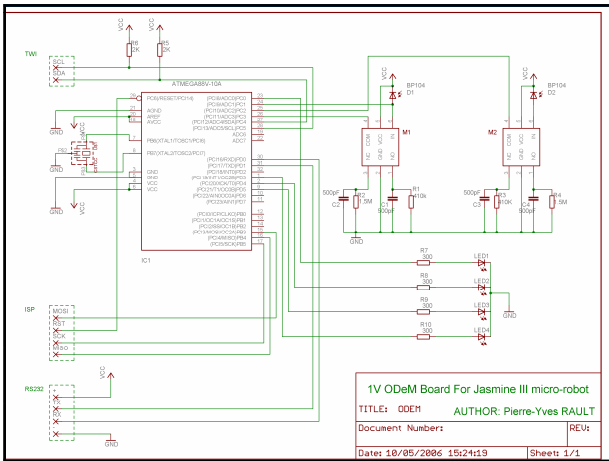
- AGENDA
- Background
    - Swarm microbot
    - Projet. Jasmine
  - Mission
    - Ego-positioning
    - Virtual Pheromones
    - Codes Transmission
  - Hardware
    - Beamer



# Embedded Hardware board

- AGENDA
- Background
    - Swarm microbot
    - Projet. Jasmine
  - Mission
    - Ego-positioning
    - Virtual Pheromones
    - Codes Transmission
  - Hardware
    - Beamer
    - Embedded Hardware board





ODEM: Optical Data-transmission system for swarm Micro-robots

AGENDA

- Background
  - Swarm micro-robot
  - Projet Jasmine
- Mission
  - Ego-positioning
  - Virtual Phenomenes
  - Codes Transmission
- Hardware
  - Beamer
  - Embedded Hardware board
- Software

## IV. Software

ODEM: Optical Data-transmission system for swarm Micro-robots

## Dual Code

AGENDA

- Background
  - Swarm micro-robot
  - Projet Jasmine
- Mission
  - Ego-positioning
  - Virtual Phenomenes
  - Codes Transmission
- Hardware
  - Beamer
  - Embedded Hardware board
- Software
  - Gray Code

# Dual Code vs Gray Code

**AGENDA**

- Background  
Swarm microbot  
Project: Jasmine
- Mission  
Egg-positioning  
Visual Phenomena  
Codes Transmission
- Hardware  
Beamer  
Embedded Hardware board
- Software  
Gray Code

Code	0	1	2	3
Dual Code	0000	0001	0011	0111
Gray Code	0000	0001	0011	0111

Logos: IWP Garching, Universität München, Forschungszentrum

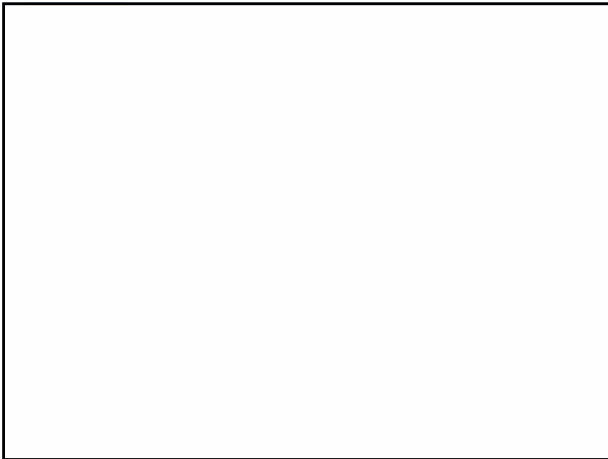
# Gray Code

**AGENDA**

- Background  
Swarm microbot  
Project: Jasmine
- Mission  
Egg-positioning  
Visual Phenomena  
Codes Transmission
- Hardware  
Beamer  
Embedded Hardware board
- Software  
Gray Code

Code	0	1	2	3
Gray Code	0000	0001	0011	0111

Logos: IWP Garching, Universität München, Forschungszentrum





ODeM: Optical Data-transmission systEm for swarm Micro-robots

## Gray Code

AGENDA

ODeM: Optical Data-transmission systEm for swarm Micro-robots

## Gray Code

AGENDA

- Background
  - Swarm micro-robot
  - Projet: Jasmine
- Mission
  - Eye-positioning
  - Virtual Phenomenics
  - Codes Transmission
- Hardware
  - Beamer
  - Embedded Hardware board
- Software
  - Gray Code

**Horizontale axe:**  
**9 pictures**  
**Resolution**  
 $1600\text{mm}/2^9 = 3,1\text{mm}$

ODeM: Optical Data-transmission systEm for swarm Micro-robots

## Gray Code

AGENDA

- Background
  - Swarm micro-robot
  - Projet: Jasmine
- Mission
  - Eye-positioning
  - Virtual Phenomenics
  - Codes Transmission
- Hardware
  - Beamer
  - Embedded Hardware board
- Software
  - Gray Code

**3 pictures: starts bits**  
**9 pictures: horizontal**  
**9 pictures: vertical**

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**21 pictures: total**

ODeM: Optical Data-transmission systEm for swarm Micro-robots

## Gray Code

AGENDA

- Background
  - Swarm micro-robot
  - Projet: Jasmine
- Mission
  - Eye-positioning
  - Virtual Phenomenics
  - Codes Transmission
- Hardware
  - Beamer
  - Embedded Hardware board
- Software
  - Gray Code

**•21 pictures: total**  
**Frequency: 60 Hz**

$16,67\text{ms} * 21 \text{ pict} = 350 \text{ ms}$

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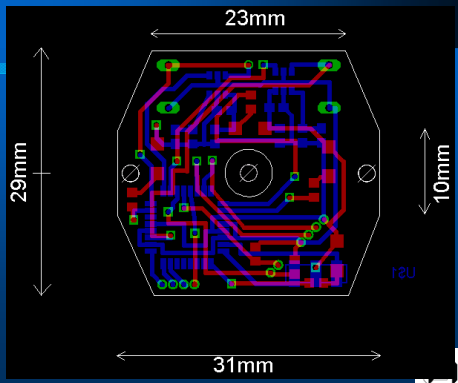
## Color-based Code

AGENDA

- Background
  - Swarm micro-robot
  - Projet: Jasmine
- Mission
  - Eye-positioning
  - Virtual Phenomenics
  - Codes Transmission
- Hardware
  - Beamer
  - Embedded Hardware board
- Software
  - Gray Code
  - Color-based Code

ODeM: Optical Data-transmission systEm for swarm Micro-robots

- AGENDA**
- **Background**
    - Swarm microbot
    - Project Jasmine
  - **Mission**
    - Edge positioning
    - Visual Phenomena
    - Colored Transmission
  - **Hardware**
    - Diater
    - Embedded Hardware board
  - **Software**
    - Gray Code
    - Color-based Code



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