A GAME OF DRONES

VISUAL SERVOING IS COMING

3INFO - Practical study | Tutor : François Bodin

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SUMMARY

- **Context of the project**
  - Keys to understand
  - Interest : automatic control & visual servoing
  - Jakopter, framework & lua
- **Work already done**
  - How we have worked
  - Benchmark, tests
  - PID : Proportional, Integral, Derivative
- **Next steps**
  - Working plan
  - Link with the image analysis group

CONTEXT

Keys to understand

*« An **unmanned aerial vehicle (UAV)**, commonly known as a drone, and also referred by several other names, is an an aircraft without a human pilot aboard » - Wikipédia*

- *Leisure*
- *Military applications*
- *Film making*
- *Rescue operations*
- …

- *No human pilot aboard : interest in automation*

CONTEXT

Interest : automatic control & visual servoing

Objective of the project :
automation of the drone, visual servoing

→ **Independance of the drone**

- *Could be used for :*
  - *Deliveries (Amazon, La Poste, ..)*
  - *Photos (GoPro's drone)*
  - *Agricultural purposes*

- *Legislation problems*

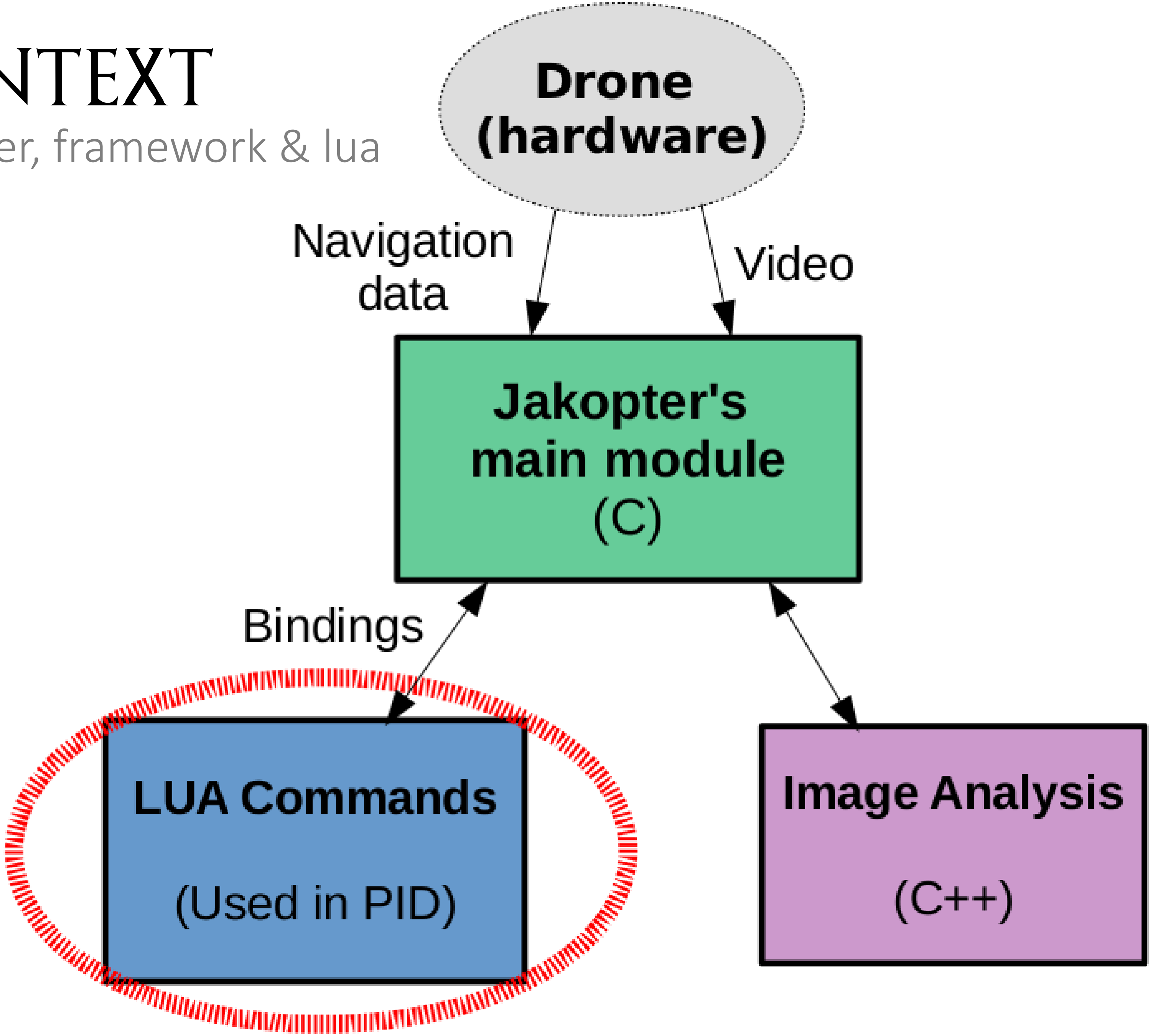
CONTEXT

Jakopter, framework & lua

	ROS	Parrot API	Jakopter
Native video interface with the AR Drone 2	✗	✓	✓
Scripting language		Lua	Lua
Simple architecture	✗	✗	✓

CONTEXT

Jakopter, framework & lua



WORK ALREADY DONE

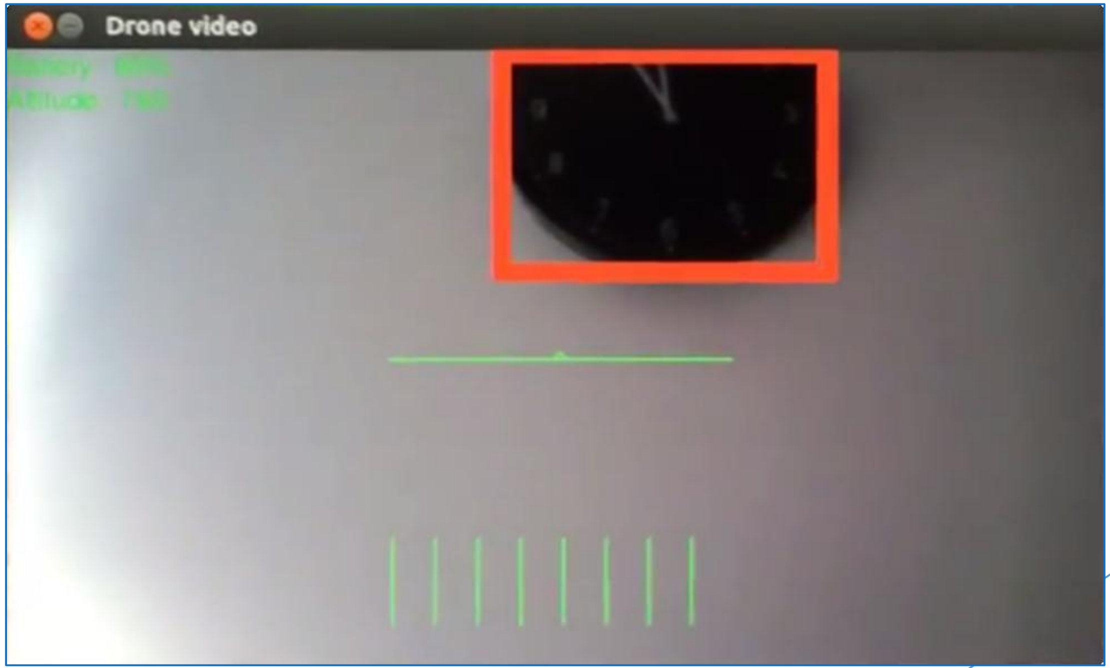
How we have worked

- 1st objective : having a demo scenario ✓
  - what the drone must be able to do at the end of the project
  - Scenario based on a student’s life
- 2nd objective : having a benchmark ✓
  - to be able to test our projet
- 3rd objective : make the PID ⏳
  - Two components of the PID done

WORK ALREADY DONE

Benchmark, tests

- 3 versions
  - 2 too sensitive to brightness and visual noise
  - 1 precise enough to perform our tests
- First and second version

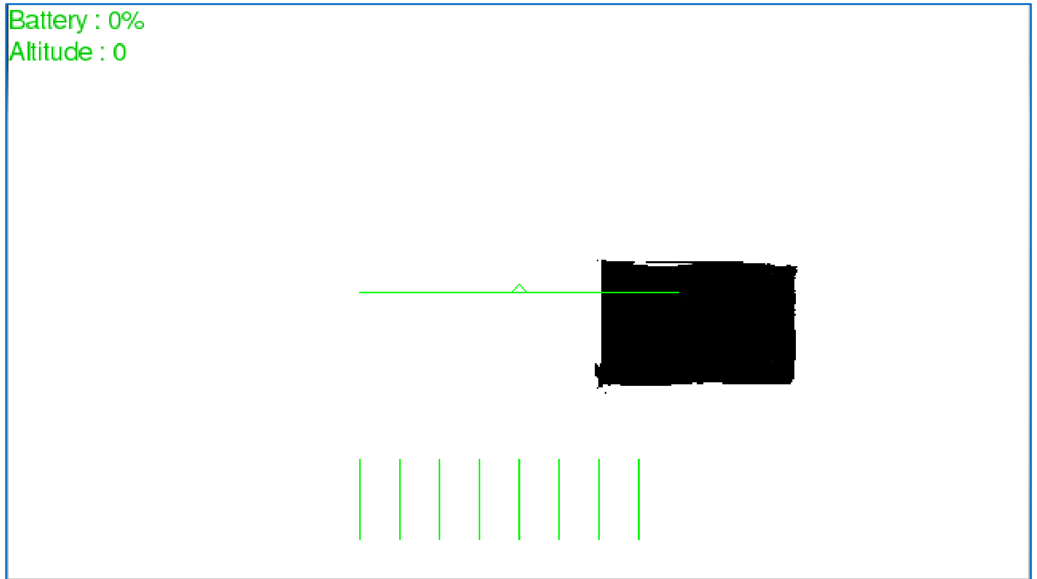


WORK ALREADY DONE

Benchmark, tests

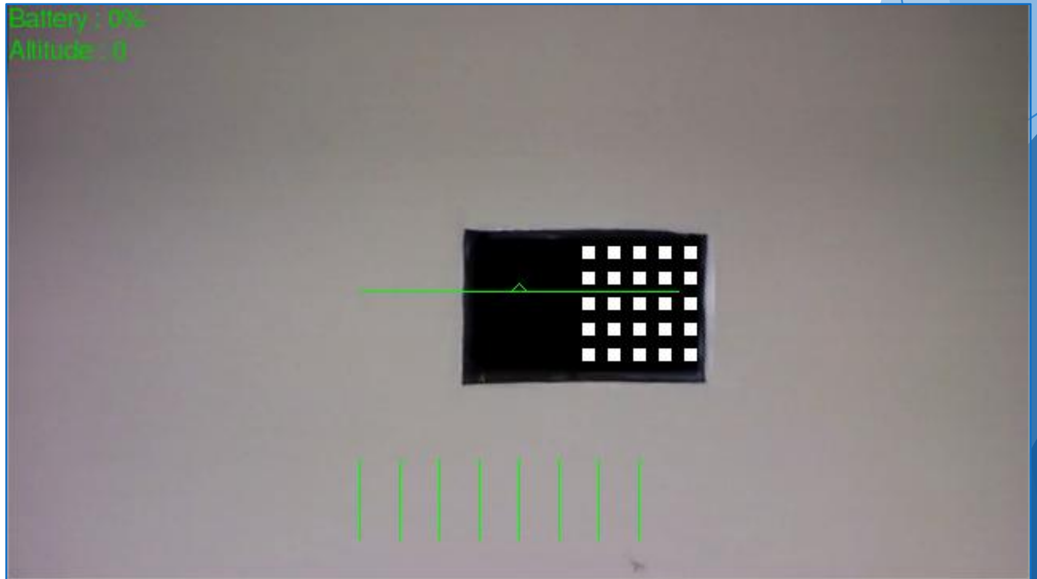
- Third algorithm
  - Computed threshold
  - Image binarization
  - Small sensors (8px * 8px)

- Binarized image



Battery : 0%
Altitude : 0

- Target located



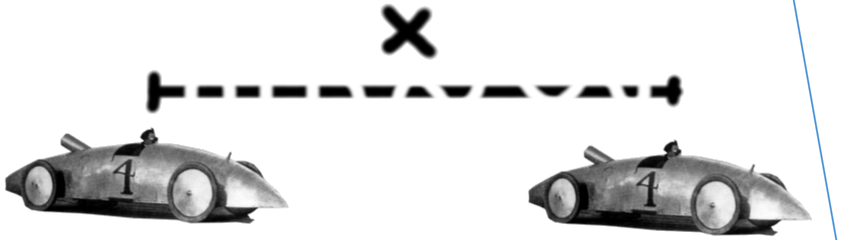
Battery : 0%
Altitude : 0

WORK ALREADY DONE

PID : Proportional, Integral, Derivative

- What is a PID ?

  Let’s use a common example!



- **1st rule : « The greater the gap between me and the ideal distance is, the more I accelerate »**

- Ouput speed is **proportional to the error value**
  → **Proportional** servoing

WORK ALREADY DONE

PID : Proportional, Integral, Derivative

- 2nd rule : « The more the sum of the gaps is increasing, the more I accelerate »

- Output speed is **proportional to the duration of the error** → **Integral** servoing

WORK ALREADY DONE

PID : Proportional, Integral, Derivative

- 3rd rule : « If the gap is becoming thinner from one time to another, I decelerate »
- Output speed is **proportional to the slope of the error over time → Derivative** servoing

WORK ALREADY DONE

PID : Proportional, Integral, Derivative

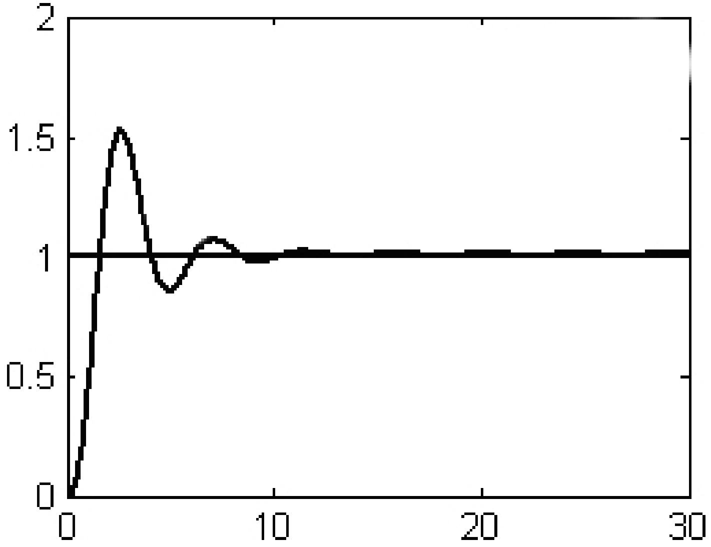
- Basic PID :

  -
    ```
    error = order - measure
    sum_errrors += error
    variation_error = error - previous_error
    order = Kp * error + Ki * sum_errors + Kd * variation_error
    previous_error = error
    ```
- By combining these rules, we can obtain a PID, but we need to find the constants (Kp, Ki & Kd)
  - Balance between precision, speed and stability
  - No other way for us than to tune experimentally the constants
  - We need a benchmark to be able to test

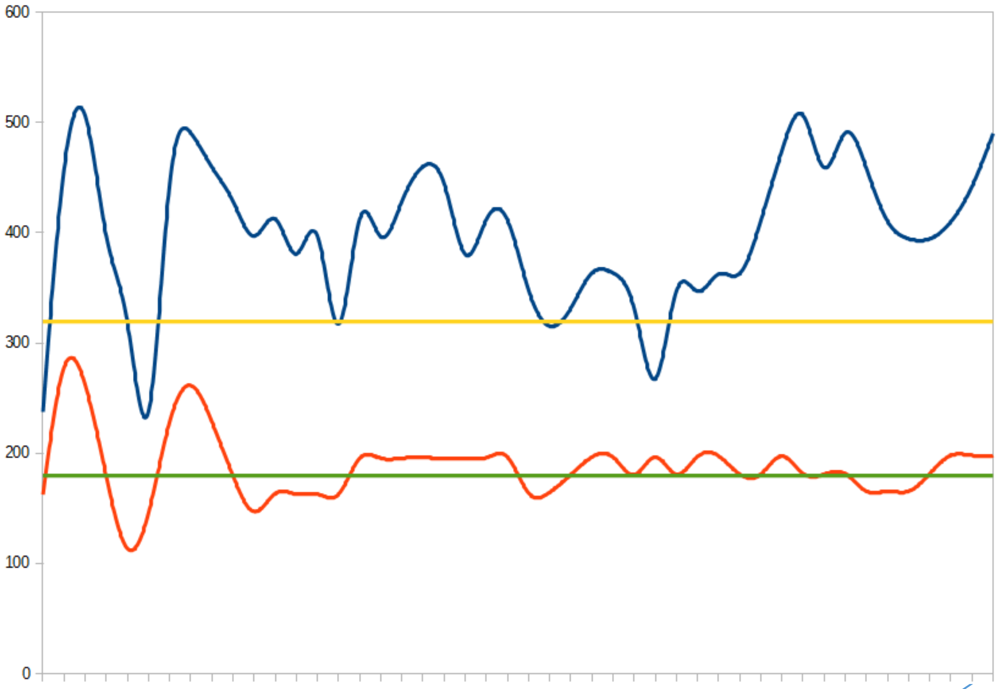
WORK ALREADY DONE

PID : Proportional, Integral, Derivative

- Ideal curve



- Our curve



- Prototype

NEXT STEPS

Working plan

- Improve benchmark
  - Angular position
  - Distance
- Finalize the PID
  - Better constants
  - Derivative component
  - Angular servoing

NEXT STEPS

Link with the image analysis group

- Implement their image analysis algorithm
  → Find an agreement on how to exchange data

- Make the demo
  - Use both cameras → another PID
  - Trigger different actions according to recognized target

CONCLUSION

- Framework : Jakopter (with Lua scripts)
- Method used : PID
- Benchmark : Done
- Tune the algorithm : In Progress
- Link the project with the other group : In Progress