Assessing Methodologies for Operational Testing and Evaluation on Biometric Black Boxes

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INTRODUCTION

- **Spread of biometric authentication solution**
  - Grant access to various applications/data
    - Critical data
      - Banking information
      - E-mails
      - Privacy
  - Necessity of an evaluation process
    - Performed by third parties
      - Manufacturer's cooperation ?
      - On operational devices ?
    - Black boxes evaluation

Presentation plan

- Presentation of the problematic
- Presentation of the two experiments
  - Common protocol
  - Nomad evaluation
  - Static evaluation
- Outcomes confrontation
- Conclusion

Presentation of the problematic

- **Biometric black boxes**
  - *e.g.* smartphones, tablets…
  - No access to intermediate data
    - Biometric samples & templates
    - Comparison scores
  - Access to final decision only
- **Constraints on the evaluation**
  - Availability for test of the users along the whole evaluation
  - Manually performed
- **Objectives ?**
  - Estimate error rate
  - **Ensure an upper bound**

PRESENTATION OF THE PROBLEMATIC

- **How to perform a biometric evaluation considering these constraints?**
  - Optimized way?
    - Industrial perspectives : time gain, reasonable costs, relevant results
    - Methodology conform to the state of the art, and standards (ISO 19795)
  - Which information could be collected during the evaluation?
    - *e.g.* To reproduce some observed error case
    - to exploit a possible vulnerability, in security test
  - How to achieve the expected upper bound?

Expected upper bound

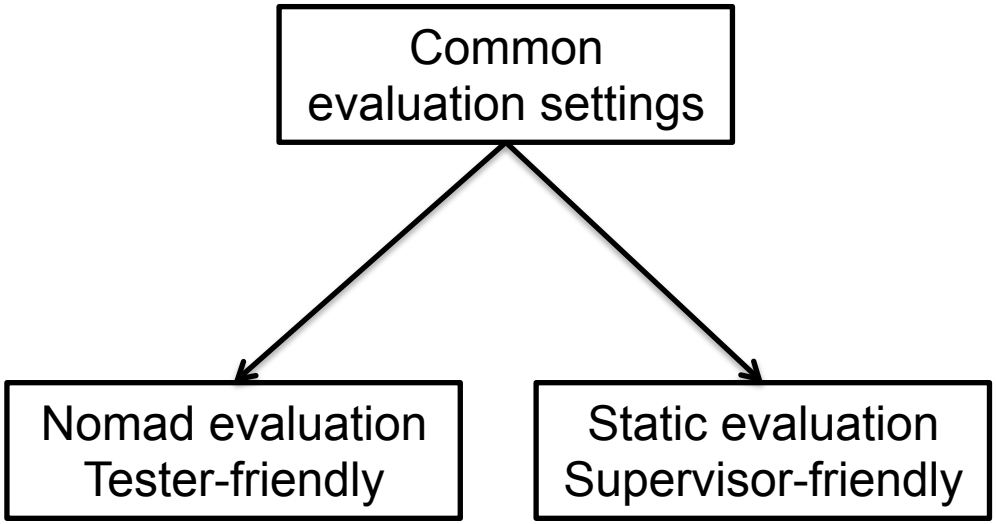
- **Objectives**
  - *e.g.* 10^{-4} ~ PIN entropy
- **Time estimation**
  - 60h
  - 10 working days
- **Population size**
  - Rule of 3 (*cf.* ISO 19795)
  - Settings :
    - 30 users
    - 8 fingers
    - 5 presentations per finger

EXISTING RECOMMENDATIONS

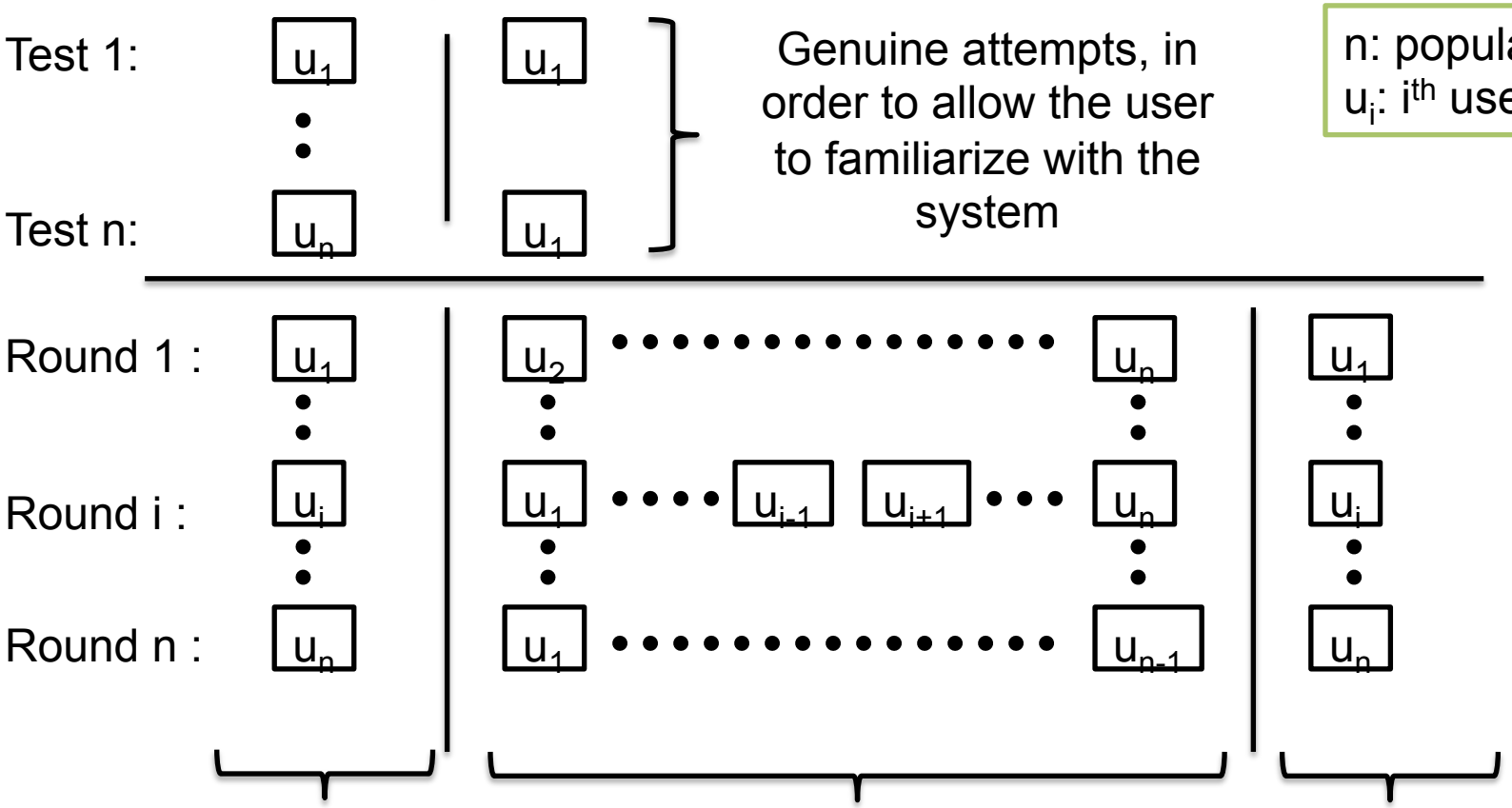
- **Standards**
  - ISO 19795 : biometric performance testing and reporting
  - ISO 29197 : Evaluation methodology for environmental influence in biometric system performance

PROPOSED EVALUATION CONDUCT

- **Two experiments:**
  - Nomad experiment
  - Static experiment

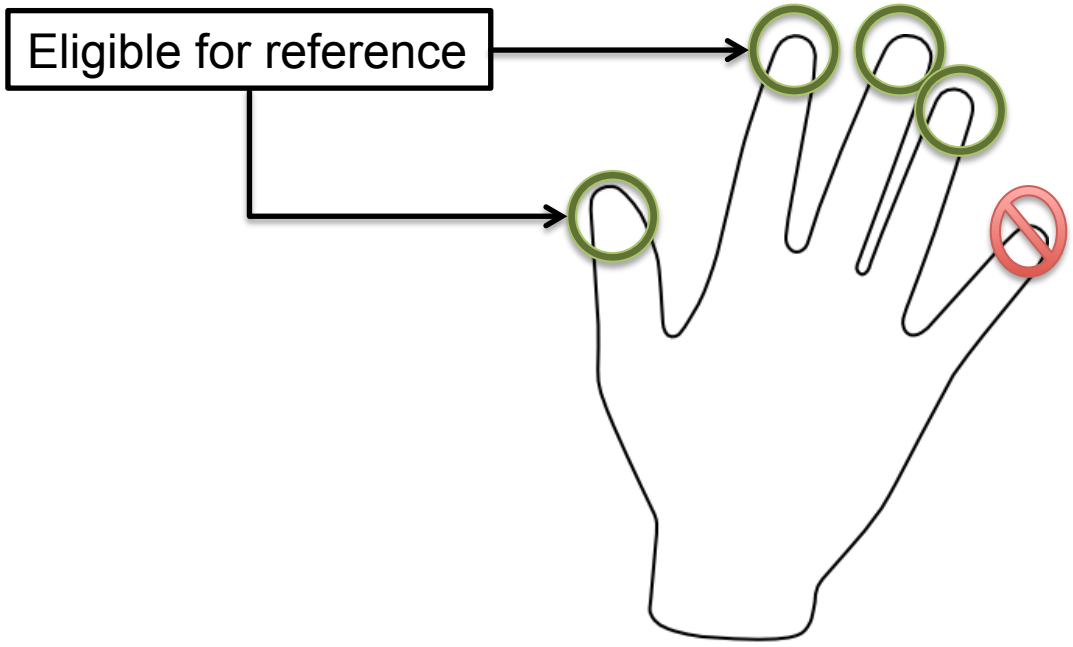


EVALUATION EXECUTION



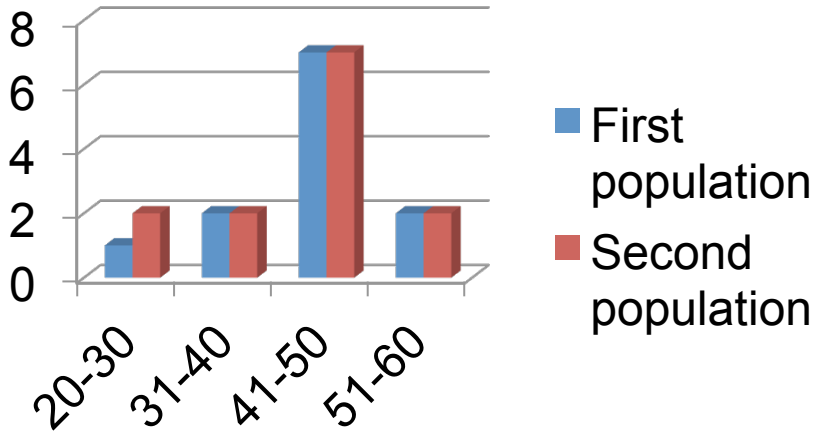
COMMON EVALUATION SETTINGS

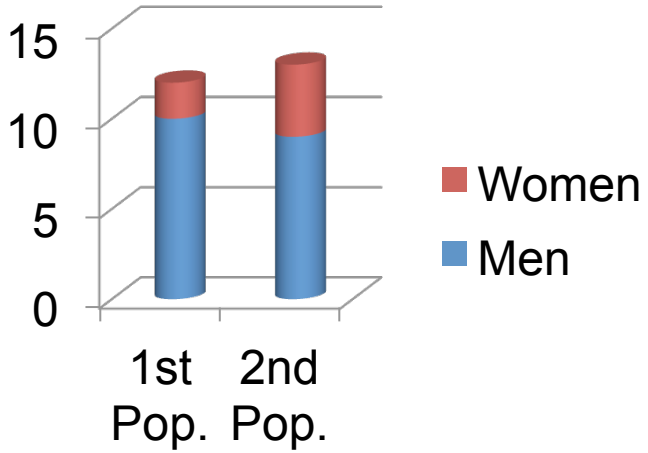
- **Unit under test**
  - smartphone
- **Presentation setting**
  - 4 fingers per hand
  - Both hands
  - Little finger discarded
    - Capture issues
- **Reference setting**
  - Thumb and index of preferred hand



Common evaluation settings

- Test populations
  - Similar size : 12 and 13 people
  - Similar gender representation
  - Similar age representation





First experiment : NOMAD evaluation

- **Base idea : trade-off between**
  - User's scarce availability for testing (not a dedicated population)
  - Time consumed
  - Execution of the evaluation
- **Specific protocol**
  - Supervisor records results (fillable forms)
  - Various offices/rooms (same building)
- **Limitations**
  - No environmental recording (conformity to ISO 19795)
  - Manual processing of the results (error rate computation)
  - Users' interaction hardly observable

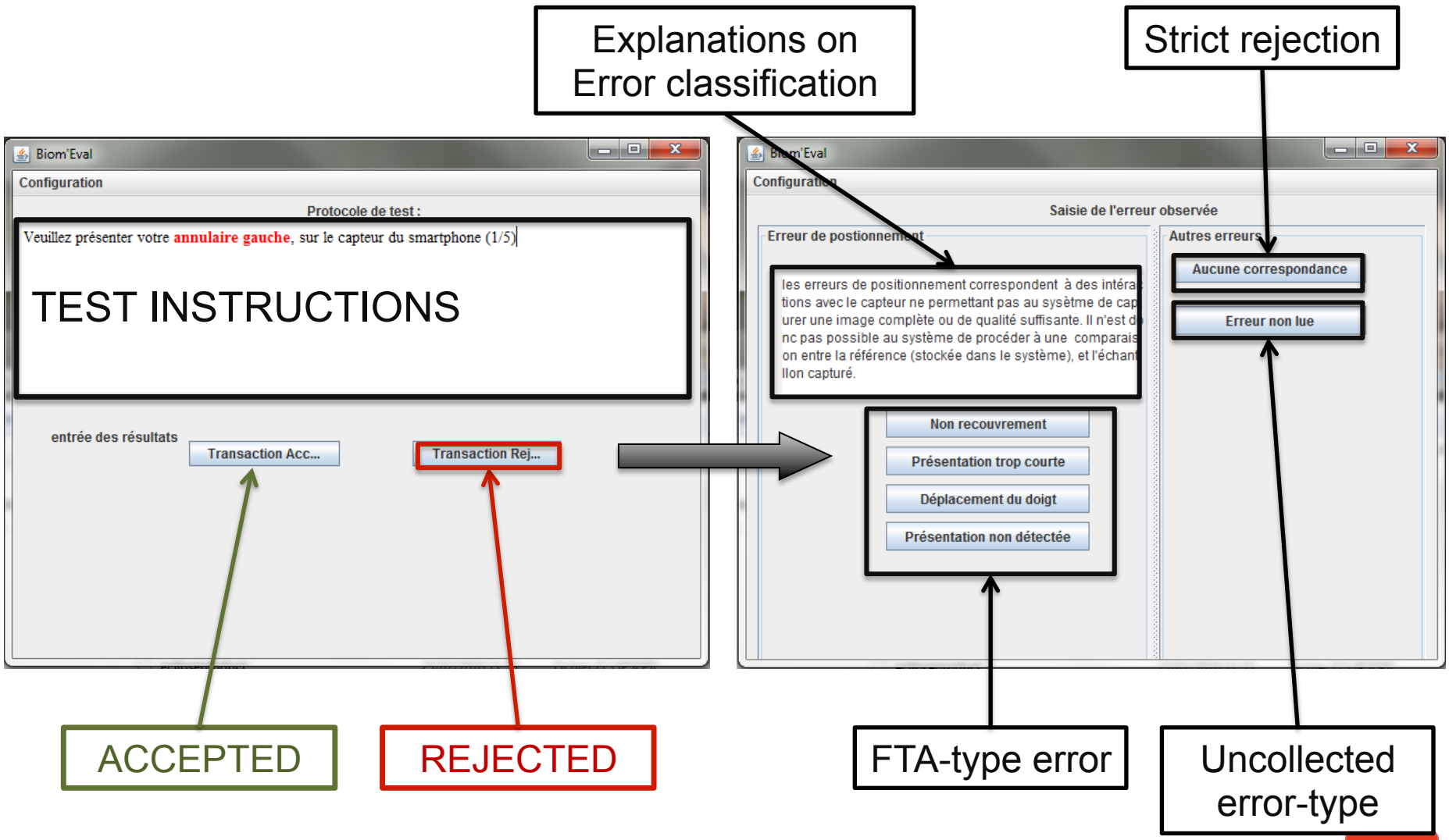
First experiment : NOMAD evaluation

- **Results**
  - Average time per session
    - First round : 6 min 30 s
    - Last rounds : ~ 2 min 30 s
  - Accommodation effect along the evaluation
    - Familiarization with the system
    - Habituation to the evaluation process
  - Observations
    - Few information collected
    - No FAR error case
  - Time consumption
    - 3 days
    - 5000 comparisons results thus FAR< 6.10^{-4}

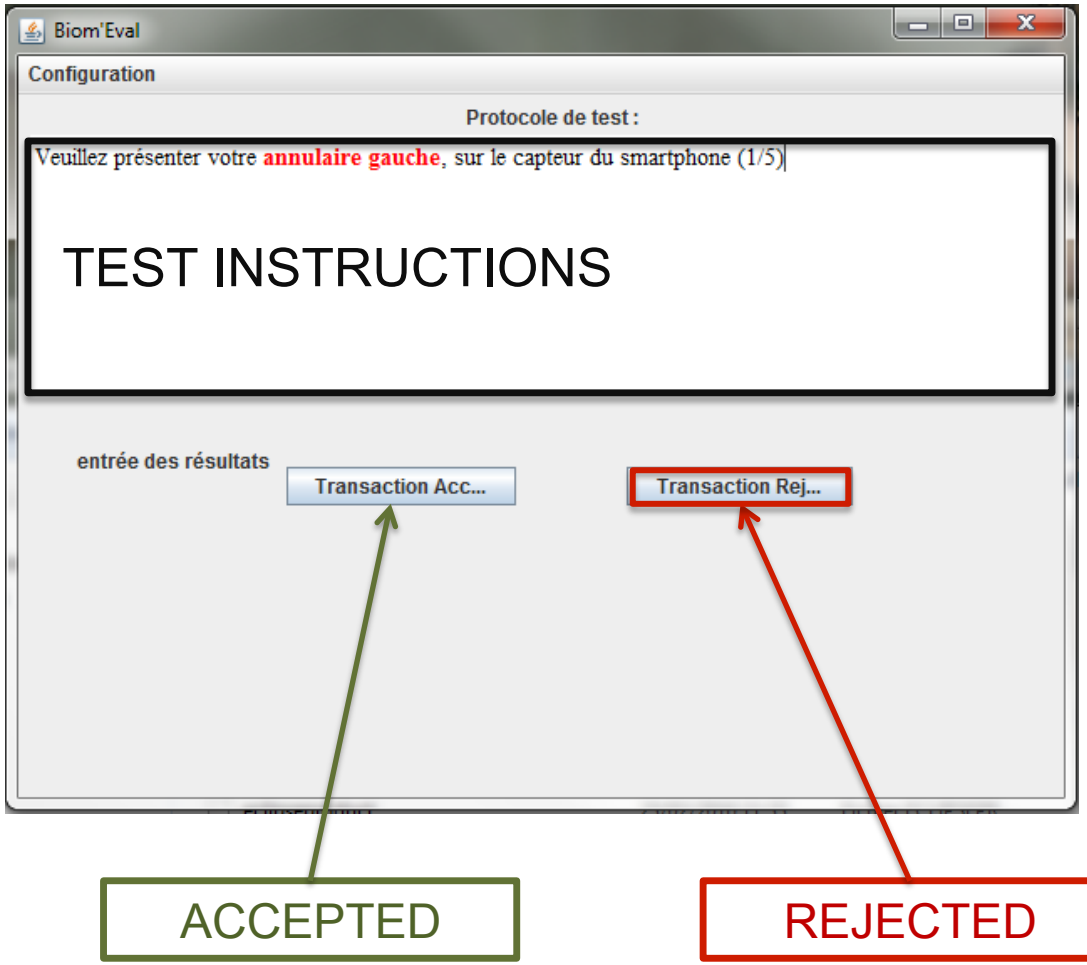
SECOND EXPERIMENT : STATIC EXPERIMENT

- **Base idea**
  - Assisted evaluation
    - Test tool : records results in a dedicated database
- **Specific protocol**
  - Users proceed to record results
  - Same location/office
  - Supervisor has time to observe interactions
    - Collect system's feedback messages
    - Determine failures' conditions
- **Limitations**
  - Less convenient for users

TEST TOOL
USER INTERFACE



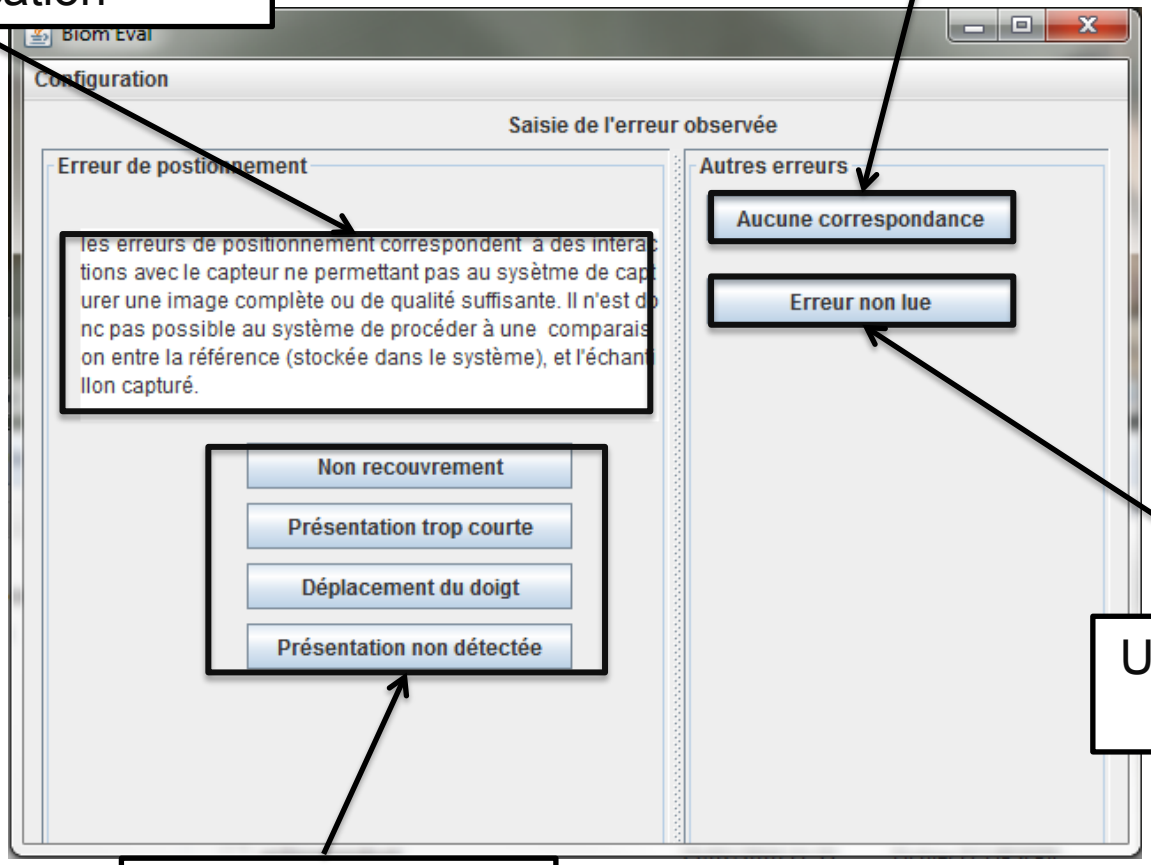
TEST TOOL
USER INTERFACE



TEST TOOL
USER INTERFACE

Explanations on Error classification

Strict rejection



Uncollected error-type

FTA-type error

SECOND EXPERIMENT : STATIC EXPERIMENT

- **Results**
  - Time consumption
    - Average time : 6 min 30 s
    - Min : 3 min 30 s
    - Max : 11 min
  - Observations
    - information collected
    - No FAR error case
  - Time consumption
    - 3 days (tests stopped)
    - 2700 comparisons results FAR < $1{,}1.10^{-3}$

METHODOLOGIES COMPARISON

	Strengths	Weaknesses
Nomad evaluation	Low time consumption Little constraining	Lack of observations No environmental conditions recording
Static evaluation	Possible observations: Interactions Modality condition Efficient system's feedback message recording	Slower Constraining for users

CONCLUSION

- **Experiments**
  - Estimation of the required time
  - Determinate difficulties
    - Test crew presence and availability for test
    - Planning the evaluation
  - Improve the test tool
    - Camera recording
- **Next step**
  - “gray box”
    - Parallel analysis of the modality
    - Ground truth (similarity score on a reference system)
  - Security part
    - Spoofing & black boxes