

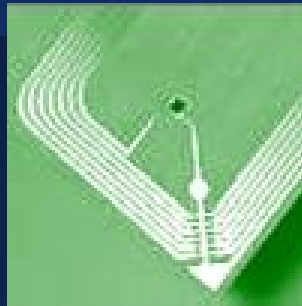


# ROS-Industrial industrial\_calibration

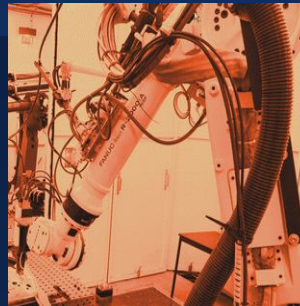
Innovating  
engineering  
projects



RFID technologies



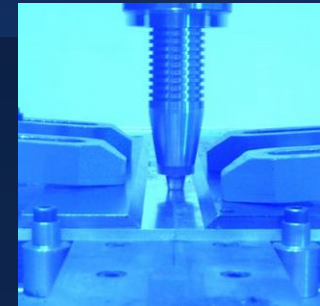
Robotic Process  
Automation



Welding, cutting,  
laser cladding



Robotic Friction Stir  
Welding



# Context 1/2

## ■ David SLS-2

- Structured light 3D sensor
- Projector + camera
- Camera can be moved closer/further to the projector to scan small/big objects



## ■ David SLS-2 sensor integrated into PCL



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## Context 2/2

- Mounting the sensor on the robot is easy :



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# Extrinsic calibration

- To use the sensor we need to calibrate the sensor on the robot :
  - Where is the sensor in regards to the robot tool?
  - It allows to get sensor data in the robot frame
- **Extrinsic calibration**



- 1 week training at SwRI « how to use the calibration package »

# What has been done

- Mounting the David SLS-2 sensor on the SwRI ABB IRB robot
- Tweaking godel calibration packages to use them for the SLS-2
- Writing a node that publishes SLS-2 images
- Defining a new trajectory for the SLS-2 (caljob)
- Printing a new target that fits the SLS-2 field of view
- Running the calibration !





# RViz + terminal

The image shows a ROS environment with a terminal window and an RViz window. The terminal window displays a series of messages from the RRTConnect and ParallelPlan packages, indicating the creation of states and the finding of solutions. The RViz window shows a 3D model of a robotic arm and two camera views of a grid of dots.

Terminal output (partial):

```
[ INFO] [1458932653.418722682]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.419853823]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.424044733]: RRTConnect: Created 5 states (2 start + 3 goal)
[ INFO] [1458932653.424420989]: ParallelPlan::solve(): Solution found by one or more
threads in 0.020078 seconds
[ INFO] [1458932653.424676425]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.425951784]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.427119884]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.432482055]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.439748675]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.444249084]: RRTConnect: Created 5 states (2 start + 3 goal)
[ INFO] [1458932653.444479065]: RRTConnect: Created 5 states (2 start + 3 goal)
[ INFO] [1458932653.446845555]: RRTConnect: Created 5 states (2 start + 3 goal)
[ INFO] [1458932653.447153349]: ParallelPlan::solve(): Solution found by one or more
threads in 0.022577 seconds
[ INFO] [1458932653.447372774]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.447433616]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.447510217]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.451070754]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.459973996]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.460668169]: RRTConnect: Created 5 states (2 start + 3 goal)
[ INFO] [1458932653.460824962]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.467283186]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.467758939]: ParallelPlan::solve(): Solution found by one or more
threads in 0.020470 seconds
[ INFO] [1458932653.468003596]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.468094254]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.468190607]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.471091375]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.477808632]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.482137055]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.482568588]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.490365752]: RRTConnect: Created 5 states (2 start + 3 goal)
[ INFO] [1458932653.490950192]: ParallelPlan::solve(): Solution found by one or more
threads in 0.023059 seconds
[ INFO] [1458932653.491263907]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.491424516]: RRTConnect: Starting planning with 1 states already
in datastructure
[ INFO] [1458932653.500606620]: RRTConnect: Created 4 states (2 start + 2 goal)
[ INFO] [1458932653.502903340]: RRTConnect: Created 5 states (2 start + 3 goal)
[ INFO] [1458932653.503642798]: ParallelPlan::solve(): Solution found by one or more
threads in 0.012496 seconds
[ INFO] [1458932653.506228190]: SimpleSetup: Path simplification took 0.002377 secon
ds and changed from 3 to 2 states
[ERROR] [1458932653.521730958]: No robot state or robot model loaded
[ INFO] [1458932658.331870105]: Current State: ACTIVE
```

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# Problems encountered

- Axis in the David SLS-2 definition were wrong : the X, Y, Z axis must be defined in the right order. (not documented from what I know)
- Target was not detected :
  - Debug the OpenCV detection node
  - Target was too close!
- Wrong YAML configuration
  - YAML is hard to debug
  - Wrong target type

# Personal opinion

- Calibration is a **KEY** package in ROS-Industrial.
- Pros:
  - It works!
  - It is sensor/robot agnostic
  - You don't need to understand the underlying optimization to use it
- Cons:
  - Documentation/tutorials are bad (or missing!)
  - Code needs some cleaning (simplification)
  - A lot of tweaks needs to be done in the YAML / launch files
  - Organization of the code could be improved
- It would be nice to have a simple GUI (I think it already exists)



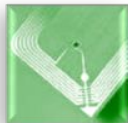
# Institut Maupertuis

The **Institut Maupertuis** is a technological research center in production and mechatronics. The institute guides companies into **products** and **production tools** innovation by making skills, production tools and methods available to them.



## Innovative engineering projects

Guidance into collaborative technical focused projects : research of industrial or academical partners, seeking for funding, project management.



## Neutral technological consulting

Consulting on production technologies and industrial applications : RFID, automation, monitoring, sensors ...



## Consulting in processes automation

Technical and economical feasibility studies, prototypes. National expert for the RobotStart PME program



## Expertise in laser processes

Industrial consulting, tests on laser platform, qualification, prototypes : Welding, cutting, cladding, 3D cutting, polishing, surface finishing.



## Friction Stir Welding

Expertise in robotic FSW assembly

L'association s'inscrit dans la politique régionale de soutien à la recherche appliquée et à l'innovation. Son pilotage est assuré par des personnalités industrielles locales en partenariat avec l'UIMM Bretagne et le CETIM. L'association est soutenue et subventionnée par l'Union Européenne (Fonds FEDER), la Région Bretagne, le Conseil Général d'Ille et Vilaine et Rennes Métropole. L'Europe s'engage en Bretagne avec le Fonds Européen de Développement Régional.



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