Half ring module loading

Lecce update

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Summary

Discussion on GE P&P approach

Discussion on main goals before July 2021

Bridge vs Pick&Place

Bridge:

PRO:

-The measuring system (xyz stages + camera) is independent from module placing and curing.

-New modules can be placed during glue curing of others already placed (but stop when a HR side is populated)

CON:

-No flexibility in changing conditions

-Manual placing in z

P&P

PRO:

-flexibility in changing conditions

-placing in z made by controlled motion

CON:

-After module pick-up Camera blind and Gantry devoted to module

-New modules can be placed only when the glue hardened enough to turn-off the vacuum (al least 1.5 hours)





Module Loading Instrumentation











Glue dispenser different for Genova and Lecce

Suction caps to be finalised

DCT

All instruments mounting on Gantry to be defined

Uniform light important for machine vision (ex. Pattern recognition)

Tools on Gantry

The best is to have all the instruments mounted on the gantry in the same time.

The only exception is the glue syringe but not the syringe holder.

For example the z-profile is very useful for the loading sequence.

The mechanical clash between instruments, stages, modules and handling frame is a problem and a risk factor to minimize.

Instrumentation on **9** or z stages



A tool attached on the theta stage could rotate not more than 180 degree. For example the soldering tool.

Power pig tail soldering

- First step standalone
- -evaluate integration: use microscope + solder on theta stage

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Mechanical clashes





xyz collision possibile for:

- Glue dispenser with syringe
- Pick&Place

Conclusion: Right now I don't see modules not reachable by the loading elements due to handling frame legs collisions

NB: This could be not the end of the story when you apply the full loading sequence.



Camera and suction caps clash





Quad-Module

Fiducial points= wire bonding pads

Module loading sequence

- 1. Mount HF on gantry and HR on HF.
- 2. Place MODULE in parking vacuum chuck
- 3. Turn-on parking vacuum chuck.
- 4. Measure X_{HR}, Y_{HR}, Z_{HR} of HR fiducial points.
- 5. Measure $X_A, Y_A, Z_A, \vartheta_A$ of MODULE fiducial points in parking vacuum chuck.
- 6. Calculate $X_{A'}, Y_{A'}, Z_{A'}, \vartheta_{A'}$ for MODULE picking-up from parking vacuum chuck.
- 7. Calculate $X_{C'}$, Y_C , Z_C , ϑ_C of MODULE fiducial points on HR.
- 8. Calculate $X_{C'}, Y_{C'}, Z_{C'}, \vartheta_{C'}$ for MODULE placing on HR.
- 9. Place syringe with glue into dispenser
- 10. Deposit glue snow flakes on dummy tile, on HR and on dummy tile again.
- 11. Remove syringe from dispenser
- 12. Place suction cups on MODULE by setting $X_{A'}, Y_{A'}, Z_{A'}, \vartheta_{A'}$ gantry coordinates.
- 13. Turn-on suction cups vacuum and turn-off parking vacuum chuck .
- 14. Place MODULE on HR by setting $X_{C'}, Y_{C'}, Z_{C'}, \vartheta_{C'}$ gantry coordinates.
- 15. Leave two hours before turn-off suction cups vacuum.
- 16. Measure $X_{C"}, Y_{C"}, Z_{C"}, \vartheta_{C"}$ of MODULE fiducial points on HR

Every point position when measured have associated 5 real numbers: $x,y,z,\vartheta,z_{camera}$ Let's not consider z and z_{camera} for now.

 ϑ_f and ϑ_B can be measured by camera with $\vartheta=0$ by focusing on the 2,3 or 4 fiducial points



We must be able to transform the x and y coordinate as measured by ϑ different from 0 to and ϑ =0.

Mathematically is easy but several source of errors can degrade the real final accuracy. The initial and final survey must be done with $\vartheta=0$.







-NB: module seen only from a fiducial point.

- -z_{1,2,3,4B} could be measured by z-profilometer before Pick.
- -z_{1,2,3,4C} could be calculated if suction cups heights known during Pick
- -Could we assume $z_{1C}=z_{3C}$ (to be proved)?

Movement during pick



-How much the module translates in X, Y and Z and rotates in the (X,Y) plane after pick? -The camera monitor a reference point and the area around for about 2 mm x 2 mm -It could be able to determine the X and Y translation and the local (X,Y) rotation and by refocusing the Z translation.

Therefore, we can correct numerically for all these movements.



-NB: module seen only from a fiducial point.

-Half ring heights could be measured by z-profilometer before Pick.

 $-z_{1D}=z_{3D}$ can not be assumed but it is very likely and worse scenario.

-z_{1,2,3,4D} can not be predicted but possible to give ranges.

Final z-position

Glue default thickness 200 um within a range of 50-250um.

Characterise the final z-position distribution with glass tiles to see the glue spread

Two complementary tests:

- 1. Fixing the final glue shape
- 2. Fixing the final z-positon from calculations

Measure the final glue height, coverage and position of the squares



Strategy:

-DO THAT DIRECTLY ON PLEXIGLASS HR this is REAL SIZE EXCERCIZE -JUST TRY AND MESURE WITH FULL SEQUENCE FROM THE RESULTS YOU DECIDE HOW TO IMPROVE

Movement after placing

-How much the module translates in X, Y and Z and rotates in the (X,Y) plane after place? -Should be small because suction cups vacuum always on.

-The camera monitor a reference point and the area around for about 2 mm x 2 mm -It could be able to determine the X and Y translation and the local (X,Y) rotation and by refocusing the Z translation.

Correct for these movements $(dx,dy,d\vartheta)$ by moving the gantry in $(-dx,-dy,-d\vartheta)$ only if: -so small that there is no risk to wet the chips boundaries with the underneath glue squares

-the module must stay rigid with the camera during the gantry movement (-dx,-dy,-d ϑ)



Glue desired properties

Strength 100 psi Desired value for thermal conductivity: > 1 WmK Radiation hardness: 15 Mrad

Desired value for viscosity: < 20 000 cp (Water ~1cp at 25 °C) Pot life > 30 minutes Curing Temp ~ 22C, time: ~1 day

Glues candidates

	SE4445	Masterbond EP30TC	Polytec TC423	StyCast 2850FT
Туре	Gel (Silicone based)	Ероху	Ероху	Ероху
Viscosity (cps) (>70k difficult to deposit)	14k	6k	45k	58k
Pot life after mixing (h)	5	1.5-2	30 min	
Cure time at RT (h)	24	48-72	24	24
Re-workability	Yes			No

SE4445 glue preparation

- 1. Keep glue containers in clean room at 20C temperature.
- 2. Rotate slowly glue container for 24 hours before mixing.
- 3. Fill a 3 cc syringe about 2/3 with elliptical static mixer.
- 4. Put syringe in vacuum for 15 mins to remove air bubbles.
- 5. Put syringe on dispenser
- 6. Deposit glue snow flakes on dummy tile
- 7. Deposit glue snow flakes on HR
- 8. Deposit glue snow flakes on dummy tile
- 9. Throw in the trash syringe and elliptical static mixer

One syringe and one elliptical mixer per module.
This is true also for the tests.
Do it on real scale.
Premixing and store at -50C possible but always one syringe module for uniformity





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20/26

Approccio 2021

- FARE POCHE COSE MA AL PIU' PRESTO : anticipiamo il più possibile.
- NON CONTARE SU COSE CHE NON DIPENDONO DA NOI: ad esempio
 - disponibilità quad-module
 - scelta colla finale,
 - half-ring in fibra di carbonio
 - arrivo Gantry da Germania
 - ...
- NON ATTENDERE LA SOLUZIONE FINALE OTTIMALE MA PROVARE TUTTA LA. SEQUENZA DI PRODUZIONE IN SCALA REALE ad esempio
 - sviluppare saldatura power pig tail stand-alone e poi eventualmente integrarla nel loading
 - partire con software non integrato e poi passare a software integrato

Goal for June 30

Full loading of a plexiglass outer half-ring with glass and silicon tiles using the almost final gantry setup

- 1. Design and realise two identical P&P heads with: suction caps, camera and light.
- 2. Design and realise two identical parking vacuum plates for module pick-up.
- 3. Design and realise two identical supports for z-profilometer.
- 4. Design and realise supports for glue dispenser (different for GE and LE).
- 5. Realize two handling frame for outer half-ring (two inner ones ready).
- 6. Realize supports to mount handling frame on gantry baseplate.
- 7. Realize two outer half-ring with plexiglass.
- 8. Realize > 26+264 cm x 4 cm glass tiles with fiducial crosses
- 9. Realize > 26+26 4 cm x 4 cm silicon tiles with fiducial crosses
- 10. Glue glass tiles on half-ring + metrology
- 11. Remove glass tiles from half-ring and clean-up
- 12. Glue silicon tiles on half-ring + metrology

Schedule

February 28, 2021 (exchange GE-LE of design realisation progresses):

- 1. Gantry installation
- 2. Tools for gantry
- 3. Inner Handling frame + plexiglass inner HR + glass tiles + silicon tiles

April 30, 2021 (exchange GE-LE of geometry and software development):

- 4. Glue glass tiles on plexiglass inner HR + metrology
- 5. Remove glass tiles and clean-up plexiglass inner HR
- 6. Glue silicon tiles on plexiglass outer HR + metrology
- 7. Outer Handling frame + plexiglass outer HR

June 30, 2021 (exchange GE-LE of geometry and software development):

- 8. Glue glass tiles on plexiglass outer HR + metrology
- 9. Remove glass tiles and clean-up plexiglass outer HR
- 10. Glue silicon tiles on plexiglass outer HR + metrology

HF, HR and Mounting on Gantry

694 mm x 446.3 mm x 45 mm



572 mm x 371.2 mm x 25 mm



452.1 mm x 285.5 mm x 45 mm



Inner HF and plexiglass HR realised by A. Miccoli





How to fix handling frame on gantry baseplate a matrix of 2.5cmx2.5 cm of M6 screws

Half ring in plexiglass

Gantry: X,Y,Z,Theta 1m x 0.75m x 0.15m x 360°











Glass and Silicon tiles

In Lecce we are cutting about 160 13 cm x 2 cm and 320 2 cm x 2 cm Silicon tiles + sparee for glue radiation hardness qualification



Silicon cleaving machine



Some Silicon Tiles