
joint constraint analysis for SciFi modules

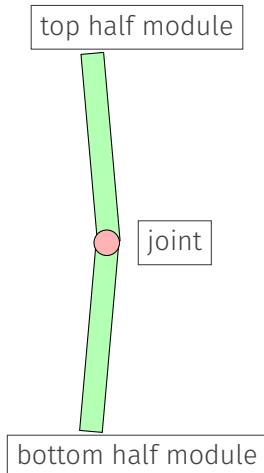
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Concept for joint constraint

- Long SciFi modules: slight "banana shape"
- Half modules in geometry to mimic
- Constrain parameters of two Alignables to each other
- $\chi^2 = (p_A - p_B)^T V^{-1} (p_A - p_B)$
- p_A, p_B : set of parameters for the half modules
- Use common frame (local half module frame)
- Errors taken from diagonal covariance matrix
→how realistic? →tuning needed
- no survey available for joint constraints so we have to tune errors like this to keep χ^2 in check



- v7 alignment, 2023 data (run 269045, warm SciFi)
- Using the Alignment master branch

```
elements = Alignables()
elements.FTHalfModules("TxRz")

surveyconstraints = SurveyConstraints()
surveyconstraints.FT(addHalfModuleJoints=True)

constraints = []
constraints.append("BackFramesFixed : FT/T3/X2/HL.*/M. : Tx Rz")
```

Joint procedure:

- Instead of one χ^2 for whole cov. matrix
→ χ^2 value for set of joint parameters
- I added the code to calculate the six χ^2 values to the software (MR coming soon)
- Tune errors by running an alignment for each change to the respective error until roughly $\chi^2/\text{dof} = 1$

Error tuning

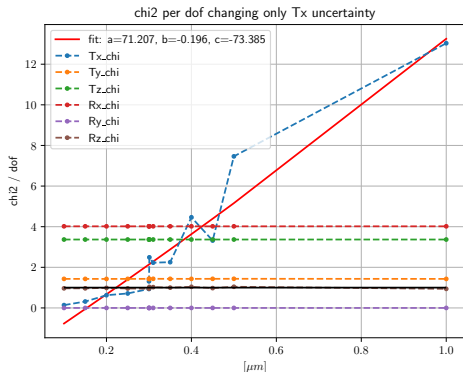
- Initial errors: 0.001 0.001 0.001
0.2 0.2 0.2 ([mm] and [mrad]
respectively)

vary Tx error (starting at 1 μm)

→ run alignment → calculate
 χ^2/dof , keep every other
parameter at nominal!

→ $Tx = 1\mu\text{m}$ not optimal,
changing the Tx error until we
find the intersection point (black
line)

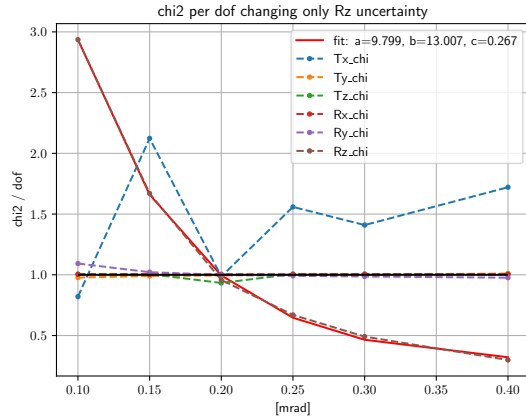
When Tx is set, continue with the next parameter and
repeat procedure



Error tuning

In the last step, R_z was tuned
intersection at 0.2 mrad was
already correctly set from
nominal

- final tuned errors: 0.0003
0.0012 0.00183 0.4 0.00044 0.2



Error tuning results

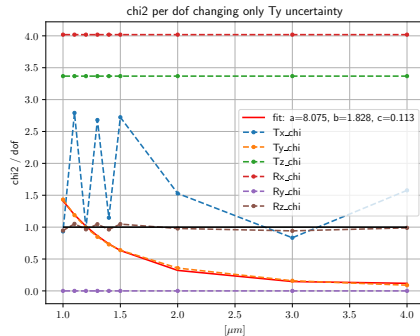
parameter	χ^2/dof before	χ^2/dof after
Tx	13.031	0.986
Ty	1.429	0.994
Tz	3.368	0.933
Rx	4.019	1.005
Ry	4.8e-6	1.0003
Rz	0.939	0.957

continuing work

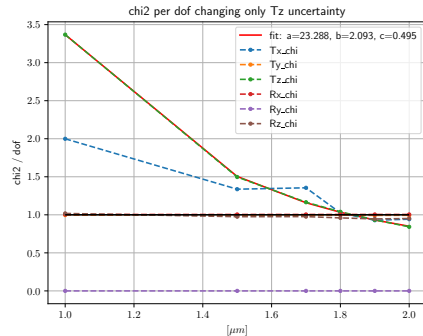
- Check the tuning with different constraints, selections
- Test tuned parameters with online stack setup

Backup

Ty tuning with Tx already fixed

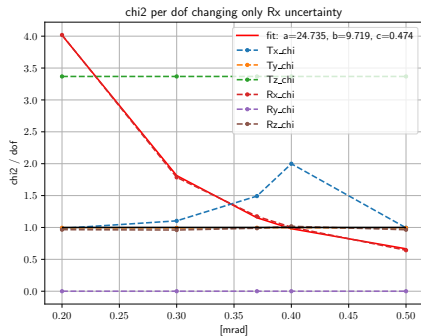


Tz tuning with Tx Ty and Rx already fixed



Backup

Rx tuning with Tx and Ty already fixed



Ry tuning with every parameter except Rz fixed

