# A control loop closure system for the Sardinia Radio Telescope active surface

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INAF Astronomical Observatory of Cagliari & National Institute for radioastronomy

#### **General parameters**





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## **Gregorian Optical Configuration**



F1/D = 0.33 -> 0.3 - 22 GHz FG/D = 2.34 -> 7.5 - 100 GHz F3/D = 1.38 -> 4.3 - 32 GHz F4/D = 2.81 -> 4.3 - 32 GHz

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#### **Metrology Tasks**



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### **Metrology Tasks**



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Star tracker (Poppi et al., (SPIE 7733, 2010)

FEM + temp sensors (Pisanu et al., SPIE 7739, 2010)

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#### Photogrammetry results @ Noto station



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#### Operation @ 100 GHz







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### **Radio vs Visible Active Optics**



Visible Range Closed loop control

> Radio Range Open loop only



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# Shape's main reflector typical measurements systems

	Time response	Accuracy	Meas. type	EL Angle
Laser Scanner	Hours/day	0.7 mm	Absolute	Any
Photogrammetry	day(s)	0.4 mm	Absolute	Any
Microwave Holography	Hours	0.15 mm	Absolute	<45 for SRT
SRT optical meas. systems	Few minutes	0.15 mm	Relative	Any





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#### SRT actuators closing loop strategy



OOF Holography planned in collaboration with GBT (R. Prestage)



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#### **General considerations**







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#### The three tested systems



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#### General considerations



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$$\begin{aligned} \alpha_{i} &= \alpha_{i-1} + \frac{M_{i}}{L_{il}} \\ h_{i} &= h_{i-1} + L_{i}\alpha_{i} \\ h_{0} &= 0 \\ \alpha_{0} &= 0 \\ \Delta \alpha_{0}^{i=1} \Delta \alpha_{i-1} &= \frac{h_{i} - h_{i-1}}{A_{i}} / \frac{M_{i}}{L_{il}^{i}} + \frac{M_{i}}{L_{il}^{2}} \Delta L \\ \Delta h_{i}^{j=0} \Delta h_{i-1} + / \alpha_{i} / \Delta L + L_{i} \Delta \alpha_{i} \\ \Delta \alpha_{0} &= 0_{2} \\ \Delta h_{0}^{i=0} = 0_{iL}^{2} M_{i} \Delta L + \frac{1}{i} \Delta M + \Delta h_{i-1} \end{aligned}$$









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#### Hartmann like



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#### Scanning Position System





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# Comparison among the three systems & Conclusions

	Segmented profile	Hartmann-like	Scanning position
Accuracy	+/-3 : +/- 70 μm	+/- 40 μm	+/- 75 μm
Sensitivity against panel deformations	medium	very hight	very low
Hardware cost	\$\$\$	\$\$	\$
Cabling complexity	high	high	low
Mounting cost	\$\$\$	\$\$	\$
Maintainement cost	\$\$	\$\$	\$
Failure probability	very high	high	low



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