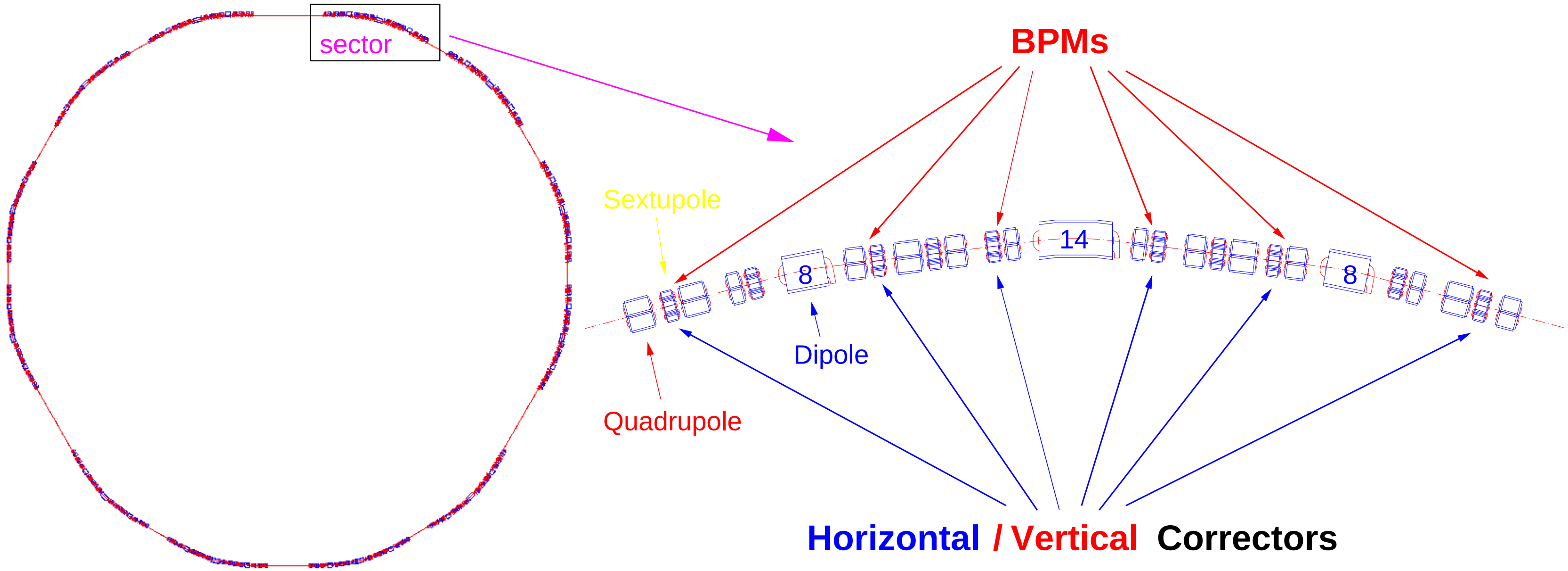
Overview

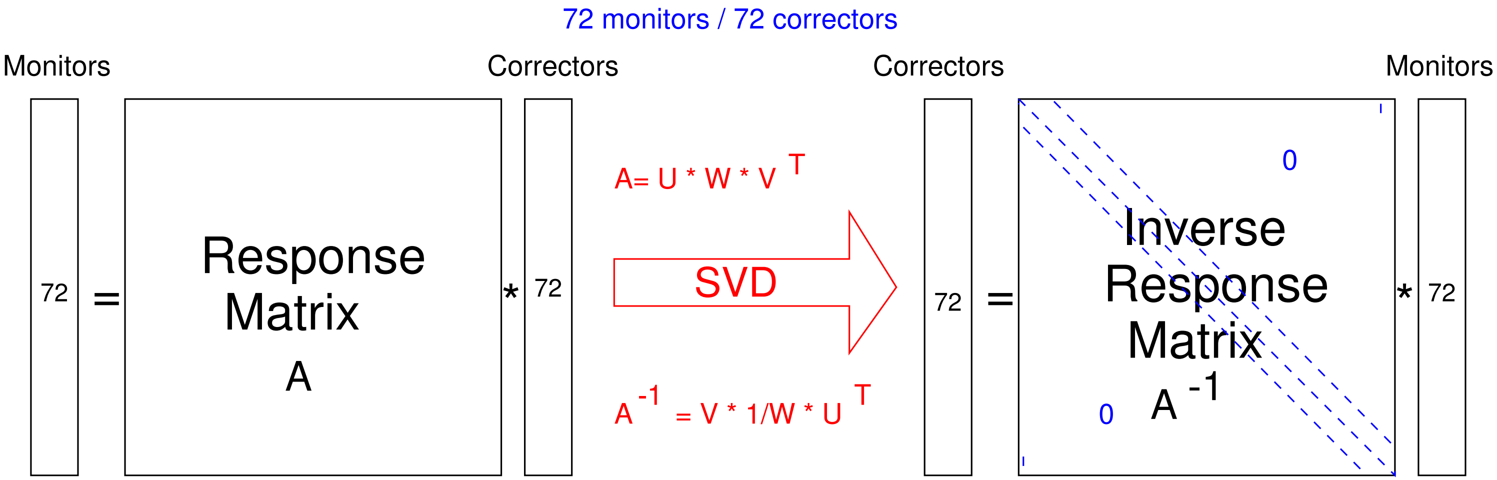
- Monitor/Corrector Layout
- Orbit Correction Scheme (SVD algorithm)
- Corrector/Monitor Response Matrices
- Consequences for the Design of a Fast Orbit Feedback

BPM/Corrector Layout

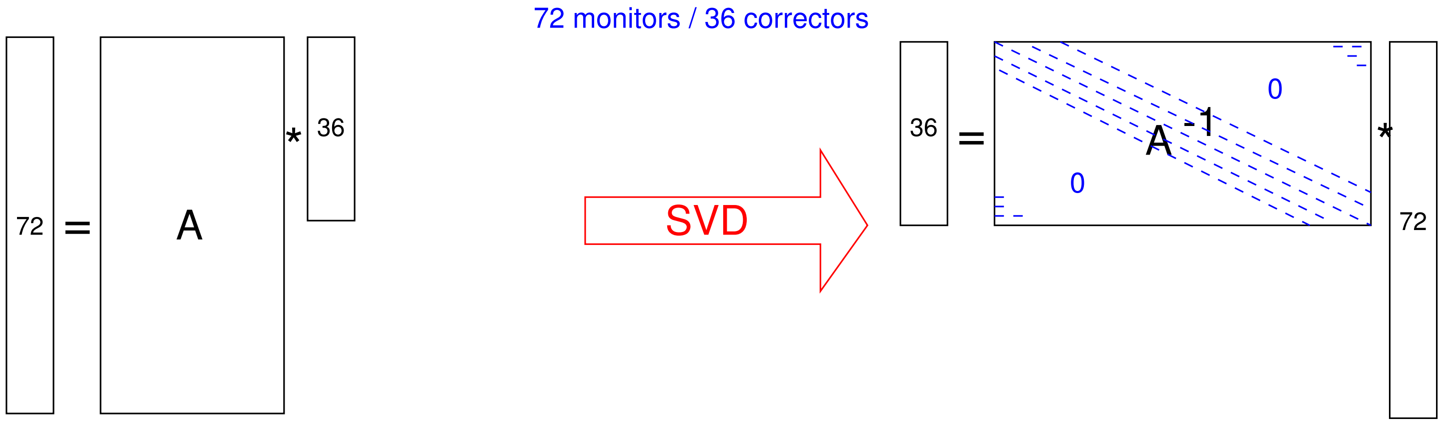


- 12 sectors
- 6 BPMs and 6 Horizontal/Vertical Correctors per sector
- Correctors in Sextupoles, BPMs adjacent to Quadrupoles

What SVD does

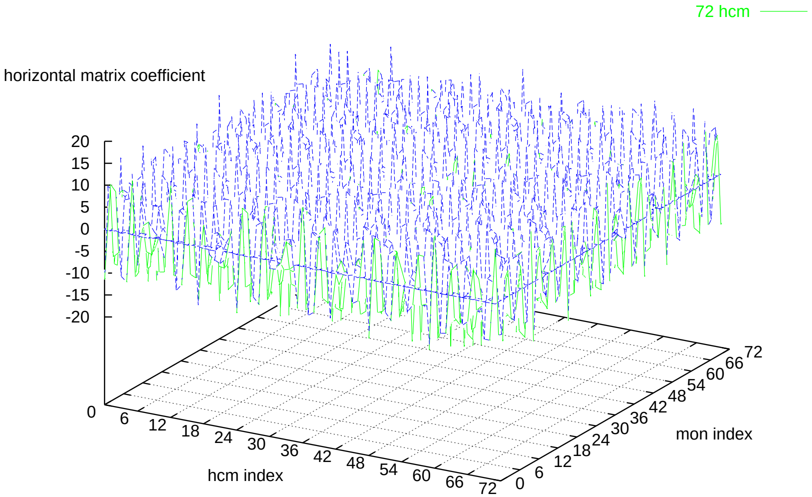


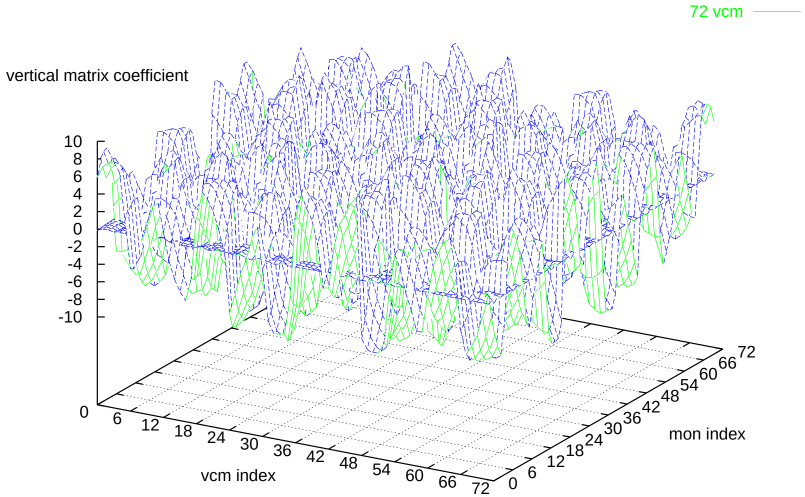
=> Minimization of the RMS orbit and the RMS corrector strength



=> Minimization of the RMS orbit (monitor averaging)

Response Matrices for the SLS SR

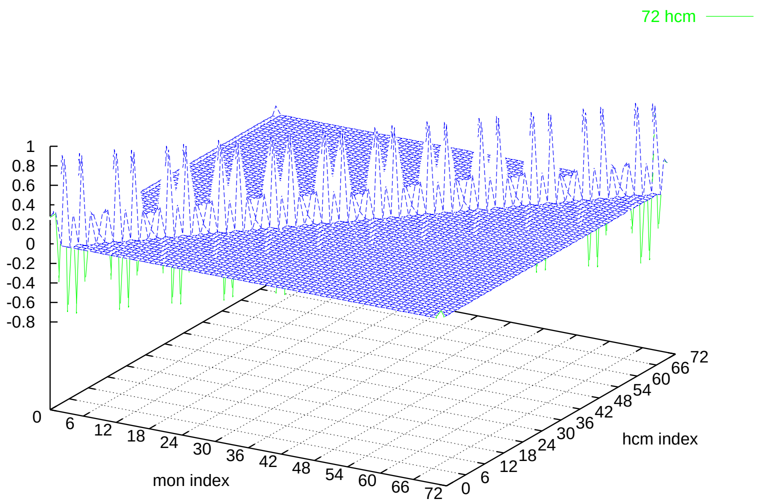


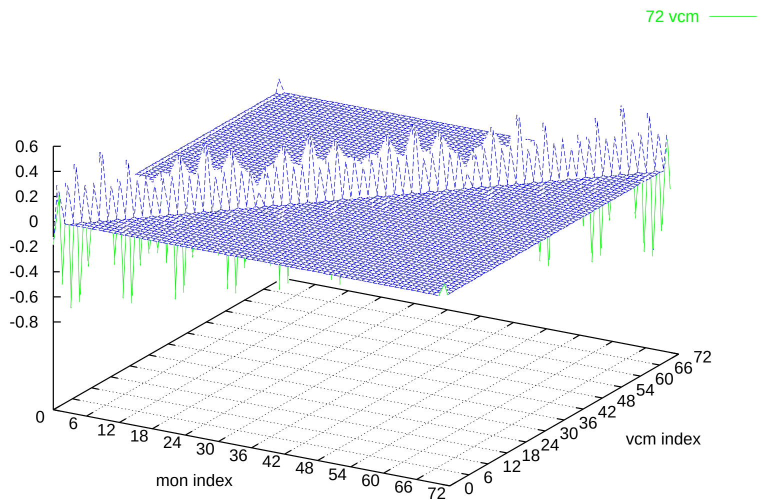


$$A_{ij} = \frac{\sqrt{\beta_i \beta_j}}{2 \sin \pi\nu} \cos\left[\pi\nu - |\mu_i - \mu_j|\right] = (U * W * V^T)_{ij}$$

- ν_x = 20.42 (≈3 monitors/correctors per unit phase)
- ν_y = 8.17 (≈9 monitors/correctors per unit phase)

Inverse Response Matrices for the SLS SR

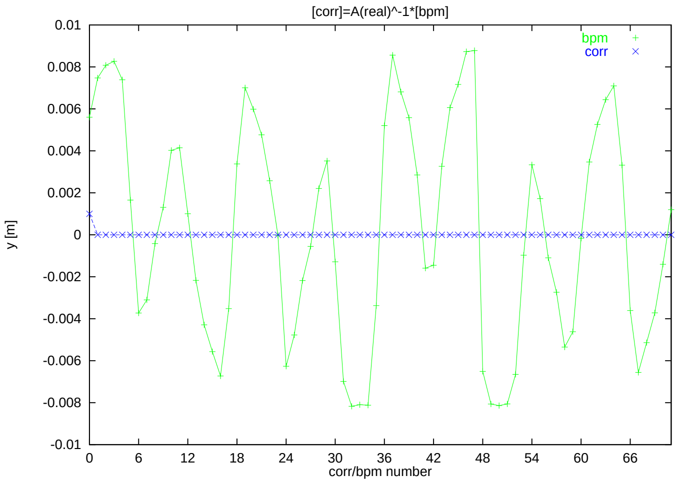


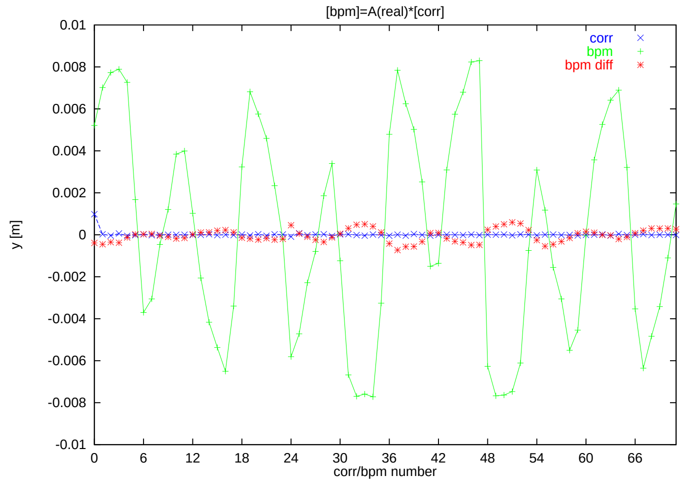


$$A_{ij}^{-1} = (V * 1/W * U^T)_{ij}$$

- A_{ij}^{-1} is a sparse "*tridiagonal*" matrix
- A_{ij}^{-1} contains *global* information although it is a "*tridiagonal*" matrix !

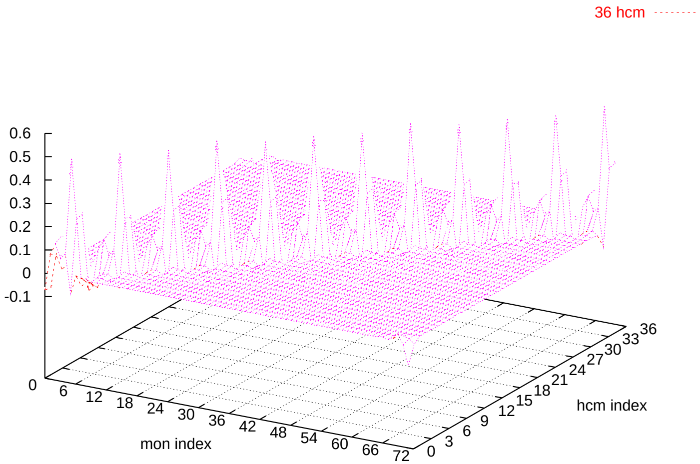
Single Corrector Example

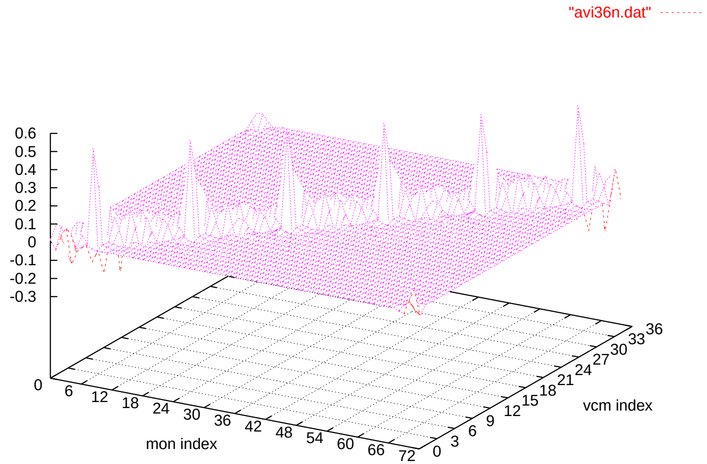


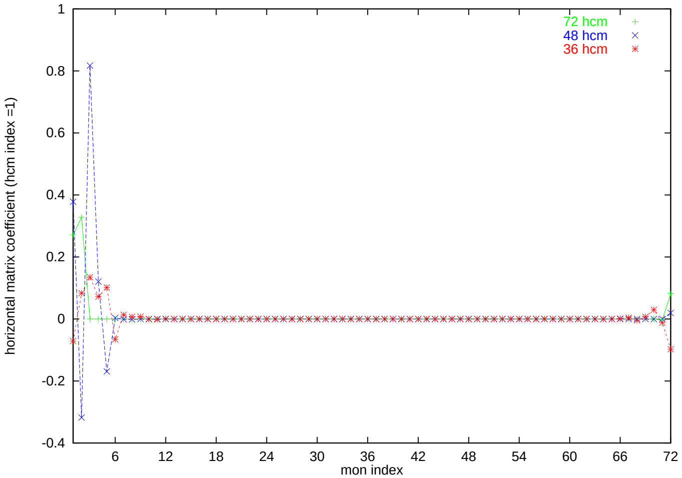


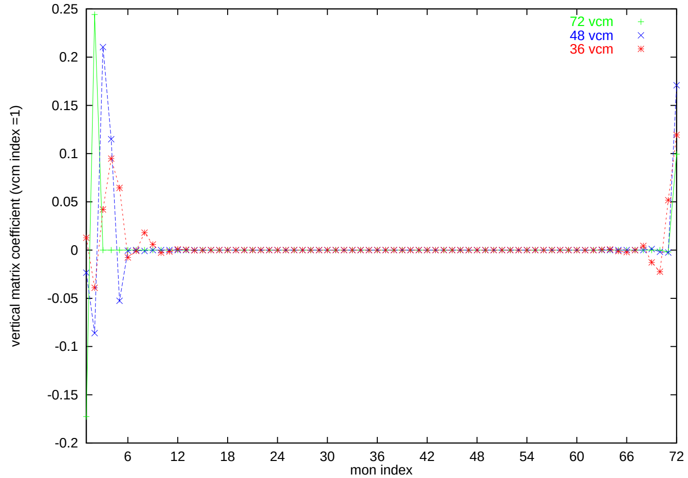
- Vertical βtron oscillation in a machine with unknown distortions
- The unknown $A(real)_{ij}^{-1}$ would predict *one* corrector
- The known $A(ideal)_{ij}^{-1}$ for the ideal machine predicts *one* corrector plus some noise on the other correctors
- Residual βtron oscillation after the correction

Inverse Response Matrices for a Small Number of Correctors

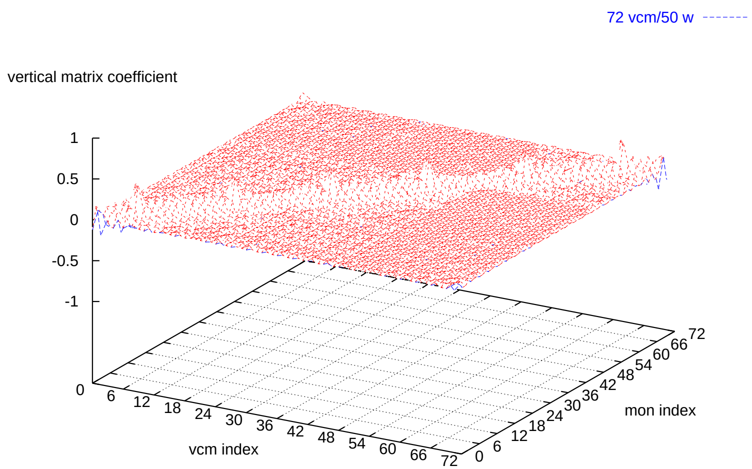


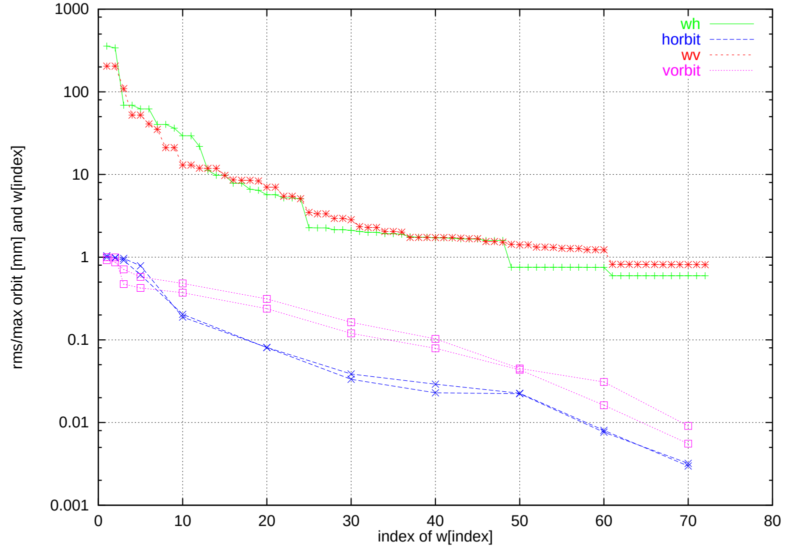




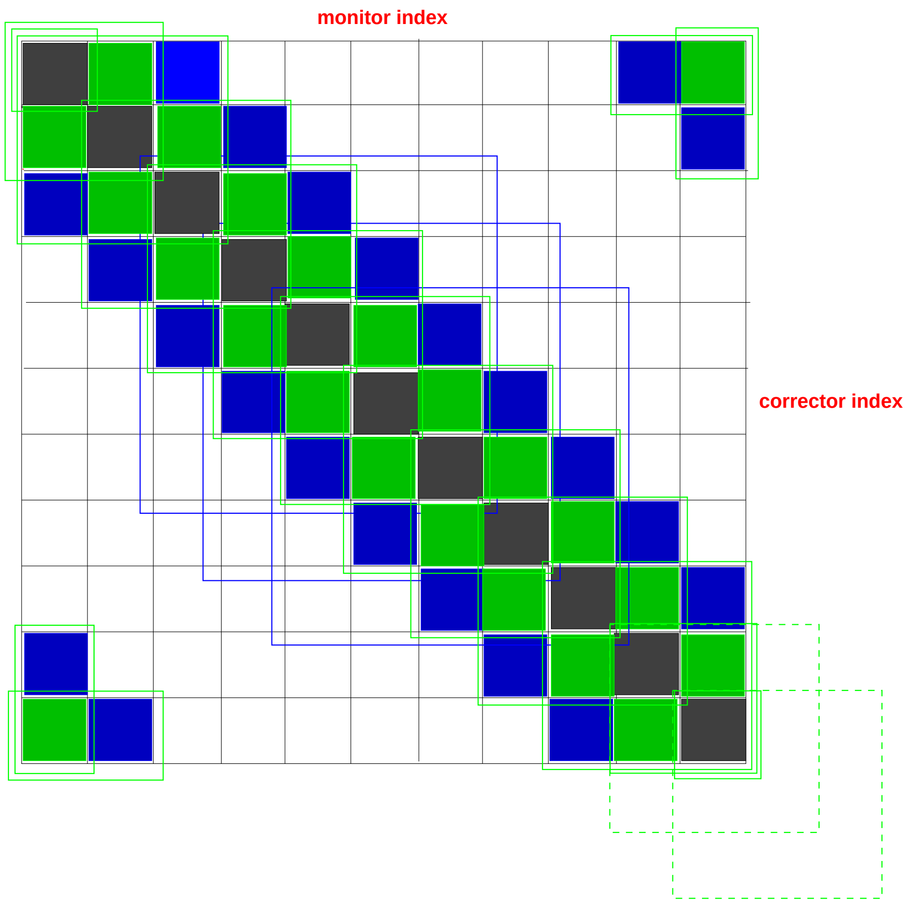


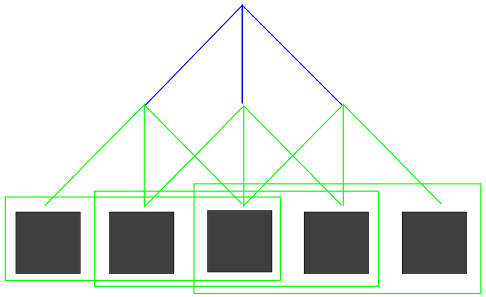
SVD Eigenvalues

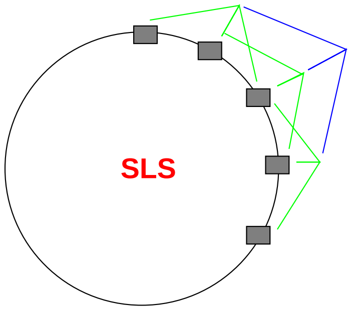




Schematic View of the Inverse Response Matrix







Schematic View of the Fast Orbit Feedback