Applicability of **Redundant Baselines Calibration Method** on Dense Phased Arrays

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Introduction & Motivation
1. Multi Source calibration method

\[
\{ \hat{g}, \hat{\sigma}_n \} = \text{argmin}_{g, \sigma_n} \| \Gamma \Phi A \Sigma \Phi^H \Gamma^H + \Sigma_n - \hat{R} \|_F^2
\]
2. Redundant Baselines calibration method

- Enough meaningful signals (high SNR).
- Enough redundant baselines.

\[ V_{ij}^{\text{obs}} = V_{k(i,j)}^{\text{true}} G_i G_j^* G_{ij} + c_{ij} + e_{ij} \]

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\[ v_{ij}^{\text{obs}} = v_{k(i,j)}^{\text{true}} + g_i + g_j + a_{ij} \]

\[ \psi_{ij}^{\text{obs}} = \psi_{k(i,j)}^{\text{true}} + \phi_i - \phi_j + b_{ij} \]
Why RB- cal. for dense phased arrays?

• Modelling the extended structures is computationally expensive.
• Detection of known sources at a given time is not guaranteed.
• In HBA frequencies, Sun is the dominant radio source.
• RB- cal. is independent on sky model.
• Redundant visibilities are not effected by the uncorrelated receiver noise.
• Regular arrangements in the array of HBA, EMBRCAE and ...
Implementation and performance
1. Recognizing the redundant baselines ...
2. Estimating the unknowns; true visibilities

Date and time of observation: 20090526, 13:12:40. At CS302, RCU mode no. 5 (freq.110-190MHz). Integration time of 1sec/ subband.
2. Estimating the unknowns; |gain of elements|
3. Estimating the unknowns; < gain of elements
3. Mutual coupling ...
Summary and Further work
• **Summary:**
  - Initial result on HBA was presented.
  - Sufficient redundancy in HBA (and EMBRACE).
  - Sky model independent.
  - Mutual coupling effect.
  - RB- Cal. on dense phased arrays (HBA, EMBRACE, …) is new.

• **Further work:**
  - on simulated data and investigate/improve the constraints; remodelling the data and …
  - Mathematical evaluation of RB- cal. as an estimator; Monte-Carlo simulation, CRLB evaluation …
  - Sensitivity of RB- cal. toward the strength of RFI sources and SNR.
  - Quantifying the errors …