# A Novel Detection Strategy for Optical Receivers with Focal Plane Array

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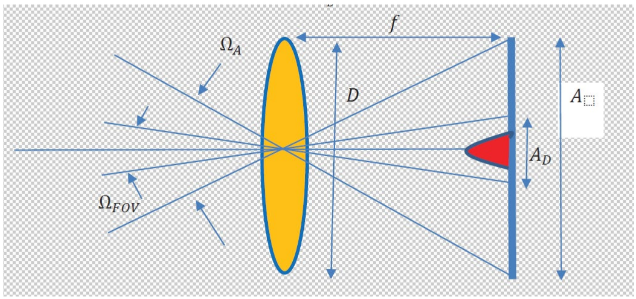
## ARRAY DETECTOR

- $N^2$ detectors in the diffraction limited foot print.
- $M^2$ total detectors.
- $A_D = f^2\Omega_{FOV}$, $A_D = N^2 A_{PD}$, $\Omega_A = \frac{A}{f^2}$.
- $\frac{M^2}{N^2} = \frac{A}{A_D}$ spatial modes




### Standard Detection Mechanism

$$\Lambda_{1,SR} = \sum_{i=1}^{M}\sum_{j=1}^{M} r_{ij}^{+}\ ,\Lambda_{2,SR} = \sum_{i=1}^{M}\sum_{j=1}^{M} r_{ij}^{-}\ ,\ \hat{d}_{SR} = \arg\max\{\Lambda_{j,SR}\}\,; j = 1,2$$

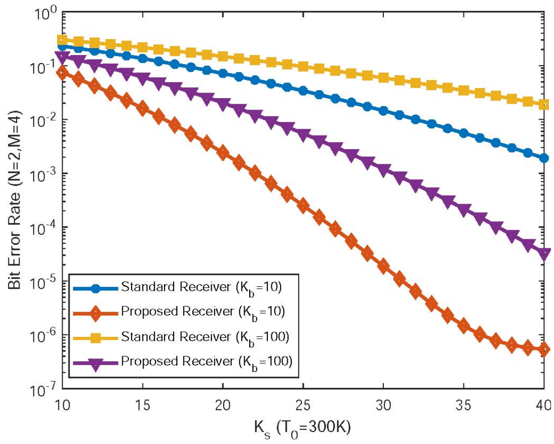
### Proposed Detection Mechanism

$$\Lambda_{1,PR} = \sum_{i,j\in\Omega} r_{ij}^{+}, \Lambda_{2,PR} = \sum_{i,j\in\Omega} r_{ij}^{-}\ , \hat{d}_{PR} = \arg\max\{\Lambda_{j,PR}\}\,; j = 1,2$$

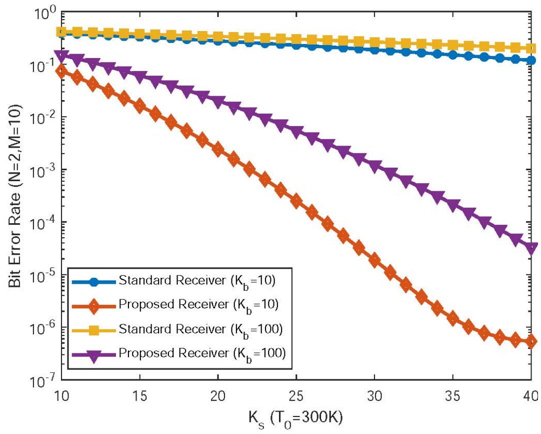
### Analytical Results

$$P_e^{SR} = Q\left(\sqrt{\frac{(\bar{g}e)^2 N^4 K_s^2}{(\bar{g}e)^2 F(N^2K_s + 2M^2K_b) + 2M^2\sigma_n^2}}\right);$$

$$P_e^{PR} = (1 - P_{FL})Q\left(\sqrt{\frac{(\bar{g}e)^2 N^4 K_s^2}{(\bar{g}e)^2 F(N^2K_s + 2N^2K_b) + 2N^2\sigma_n^2}}\right) + 0.5P_{FL}.$$




Bit error rate of the PR and SR for various background noise levels when $\bar{g} = 200$ and $P_{FL} = 10^{-6}$.




Bit error rate of the PR and SR for various background noise levels when $\bar{g} = 200$ and $P_{FL} = 10^{-6}$.

## CONCLUDING REMARKS

In this paper, an array detection strategy was proposed. The proposed detector took advantage of a recently introduced algorithm for identifying the location of the signal-bearing detectors in a focal plane array receiver. The proposed receiver outperforms the standard array detector by a significant margin over a wide range of background noise levels. Furthermore, we showed that the proposed receiver performance is independent of the size of the detector array while a standard receiver performance is impacted adversely by an increase in the size of the detector array due to background noise. Therefore, the proposed receiver proved to be a viable detection strategy in background noise limited free space optics communication channels.