
Diego Betancourt
Carlos del Río Bocio
- The photoreceptors at the Macula (cones) are 1.5 μm diameter and separated 0.5 μm.
- Quasi regular hexagonal lattice
- Visual acuity or angular resolution...

*50 second of arc*
– This approximation shows some weak points:
  • What happens if the two sources are colored? The resolution should be significantly worst…
  • The Human Eye able to distinguish smaller details.
  • The Minimum Visible is similar to 1 second of arc.

– *Hyper-acuity* is the common term used for this effect
Human Eye

• How the hyper-acuity could be justified?
  – Additional effects in vision:
    • It is well known that the cones are
      – strongly coupled, increasing the signal noise ratio
    • Other factors,
      – light diffraction and
      – quick movements of the eye to avoid photoreceptors saturation,
  – All these effects create some “diffusion” of the images on the retina, despite being optically perfectly focused.
  – In other words, all the radiating areas of all the beams that the Human eye is able to distinguish are strongly overlapped.
Human Eye

- An acceptable value for the Minimal Angle of Resolution (MAR) is 1 minute of arc
- Equivalent to an uniformly illuminated circular aperture of 1 mm radius ⇔ Pupil!!!

<table>
<thead>
<tr>
<th>Angle</th>
<th>D (dB)</th>
<th>( R_{aper} ) (µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1’</td>
<td>80,99</td>
<td>1.086,14</td>
</tr>
</tbody>
</table>

- To have 1 degree well focused…
  only ONE lens used, and more than 360 SIMULTANEOUS beams properly defined
Introducing CORPS

- The **Coherently Radiating Periodic Structures** (CORPS) work exactly as the human eye does,
  - coupling coherently (phase independent) to the surrounding elements of the array
  - controlling that coupling with the periodic disposition of the radiating elements
Coherently Radiating Periodic Structures

- **First idea** ⇒ Consider the array as a periodic structure and use the mutual coupling smartly
  - All the elements are equally shaped and resonate at the same frequency
Coherently Radiating Periodic Structures

• Second idea ⇒ Select the distance to have a coherent mutual coupling (an effective wavelength of the coupling mechanism)
  – The coupled power will be coherent (in phase), similarly as in the leaky wave antennas
  – Substrate wave modes could be used as a good coupling mechanism with planar antennas
Coherently Radiating Periodic Structures

- Ensuring the coherent coupling between elements, a second harmonic Bragg structure is defined, so a rejecting filter will be automatically tuned...
Coherently Radiating Periodic Structures

- Only the surrounding elements will couple some power!!!
- The coupling is controlled.
• The mutual coupling sometimes could be difficult to control, and it is not as strong as we could need to improve the radiating performance.

• But the same idea could be applied to the BFN…
CORPS-BFN

- In transmission, a clear overlapping of the different beam could be defined at the radiating aperture.

- Improving the **angular resolution** of the multibeam system.
CORPS-BFN

- In reception, the spatial diversity is applied:
  - Reduction of the complexity of the detectors (SNR)
  - A post-processing is required to obtain the information of each pixel
  - The image resolution (pixels) could even be improved
Analogy with Human Eye

**Concluding:**
- CORPS-BFN as a possibility of control the coupling mechanism
- Simple detectors
- Simple post-processing
- Robustness

Inner limiting membrane
Axons
Müller cell
Ganglion cell
Amarine cell
Bipolar cell
Horizontal cell
Rod
Cone
Retinal pigment epithelium

**CORPS-BFN**
Fabricated CORPS-BFN

Config. A  Config. B

Config. C  Config. D

(a)  (b)  (c)  (d)