A Comparison of Antenna Placement Algorithms

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Contributions

- Formulation of the antenna placement problem
- Evaluation of standard stochastic algorithms on a real-world problem
- Able to achieve global optimum with as low as **25% evaluations** of search space

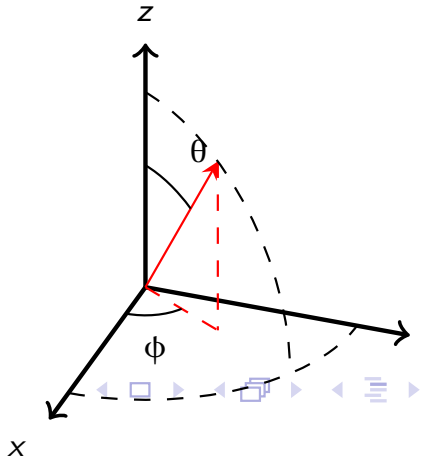
Minimize Difference in Radiation Pattern

Pattern defines the ratio of energy radiated and input energy in a particular direction. For each antenna A_i:

$$F_{RP} = \sum_{i=1}^{n} \sum_{\theta=0}^{\pi} \sum_{\phi=0}^{2\pi} \left(FSG_i(\theta,\phi) - ISG_i(\theta,\phi)\right)^2, \qquad (1)$$

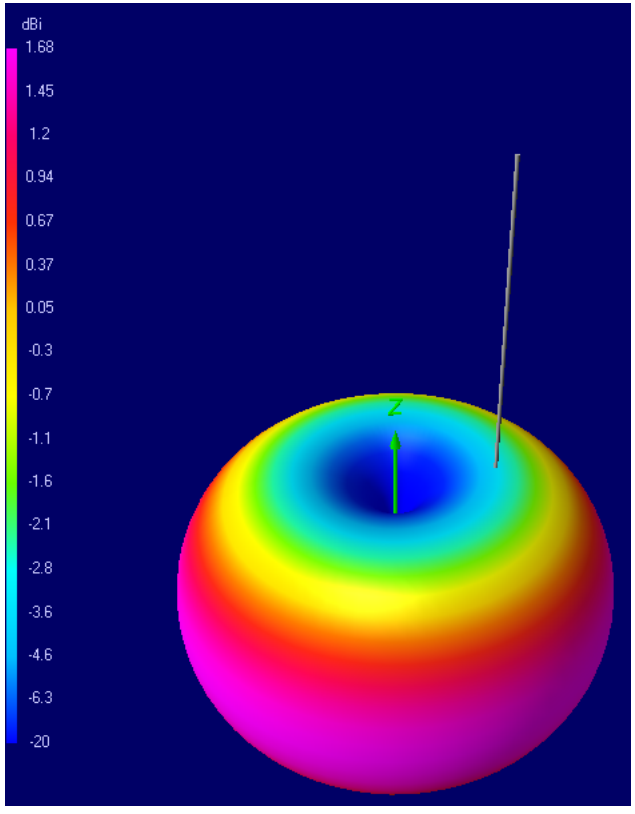
where

- θ, ϕ spherical coordinates
- $FSG(\cdot)$ returns free-space gain pattern
- $ISG(\cdot)$ returns in-situ gain pattern

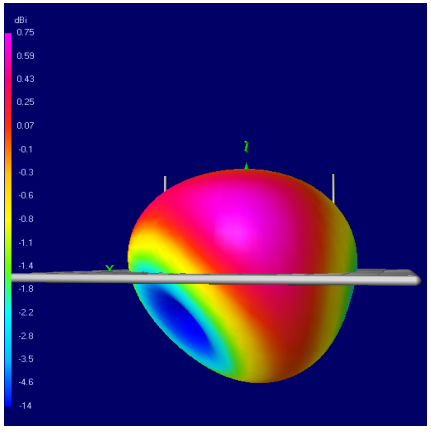


Radiation Pattern

Free-space pattern without platform or other antennas

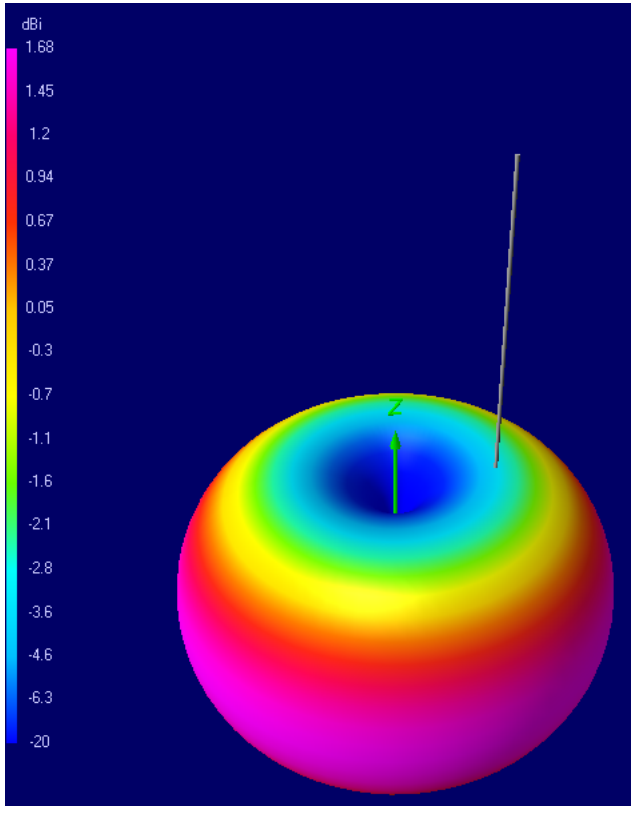


Random in-situ pattern with platform and antennas



Radiation Pattern

Free-space pattern without platform or other antennas



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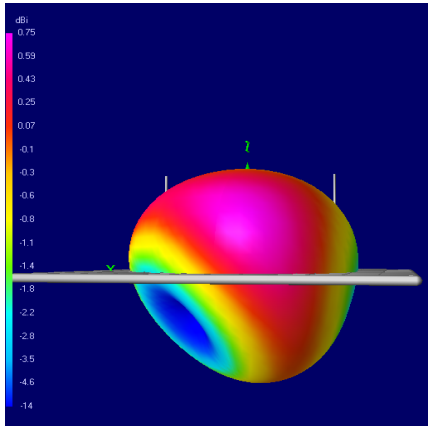
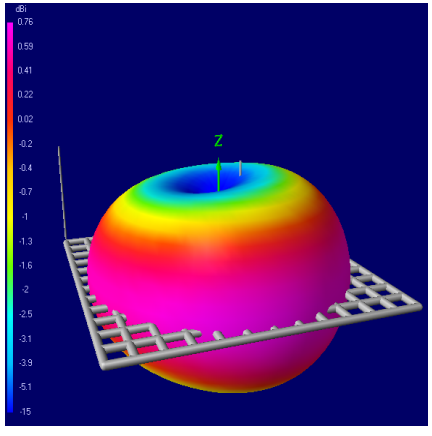
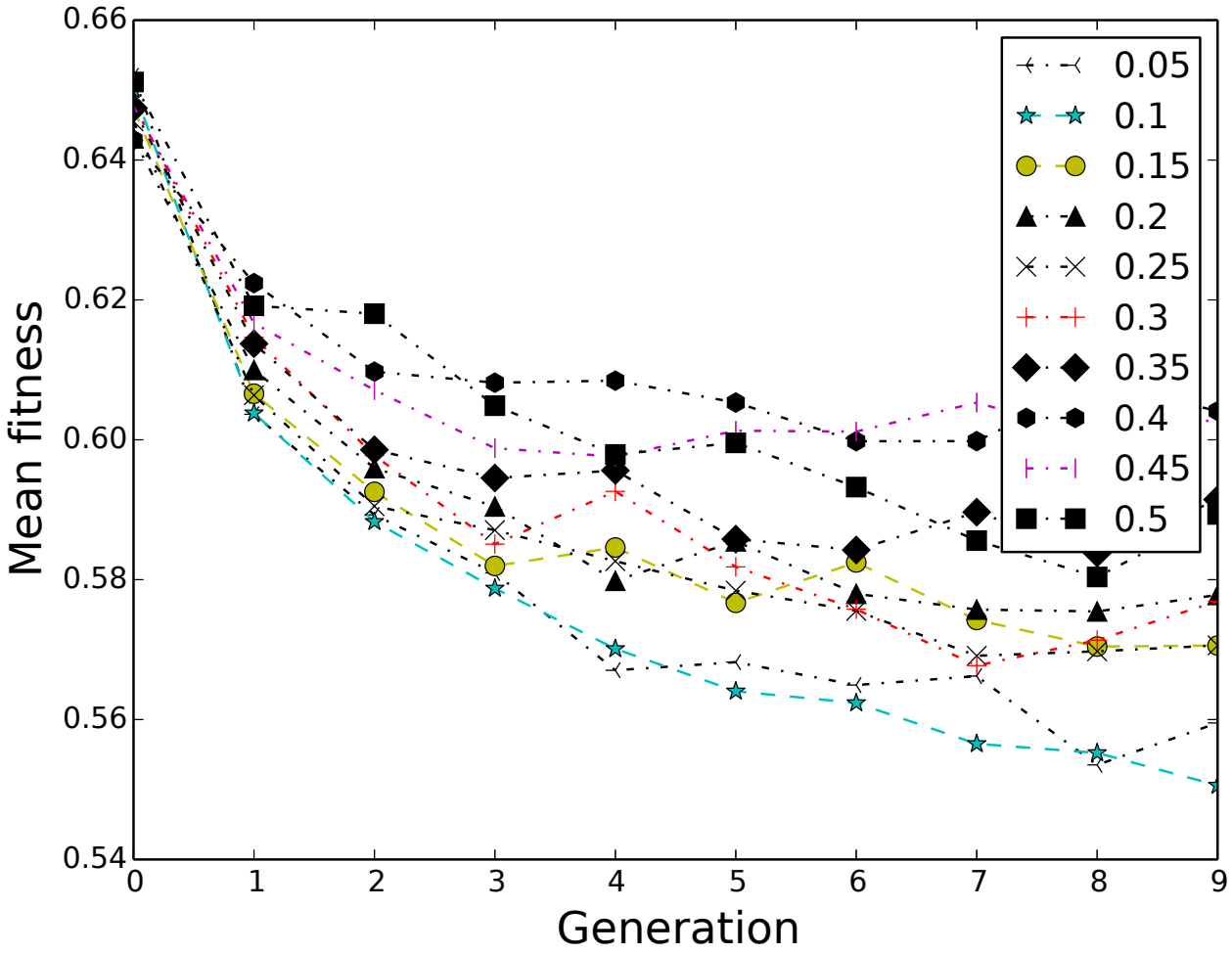


Best in-situ pattern with platform and antennas similar to free-space pattern



GA with different mutation rates



Equivalence of fitness to efficiency

For a particular test case, fitness change of 0.01 is equivalent to either the corresponding value under expected gain ($\mathbb{E}_g$) column, or difference in coupling (Δ_c).

ID	$\mathbb{E}_g$	Δ_c (dB)
tc1	872.277	0.5474
tc2	862.082	1.3034
tc3	861.845	1.5180
tc4	871.049	0.5693

$\mathbb{E}_g = \frac{1}{N \cdot m} \Sigma_i^m F_{RP}(A_i)$, where $N = |\theta| \cdot |\phi|$