Innovative Reflectarray Design Through Non-Radiating Surface Currents

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Abstract

In this work, the design of new-generation reflectarrays is dealt with. To this end, an innovative synthesis technique is developed to design the reflectarray surface currents that satisfy both radiation and arbitrary geometry constraints. Accordingly, the reflectarray design is formulated as an inverse source problem, and the non-radiating contribution of the current is profitably synthesized in order to cancel the overall current within selected "*forbidden regions*". Some preliminary results are presented to assess the effectiveness of the developed approach.

Contents

1 Preliminary Numerical Assessment

Parameters

- Number of reflectarray elements: $M = N = 55$;
- Operative frequency: $f = 14$ [GHz];
- Polarization: X-CO;
- Number of elements in the forbidden region: $Q = 44$;

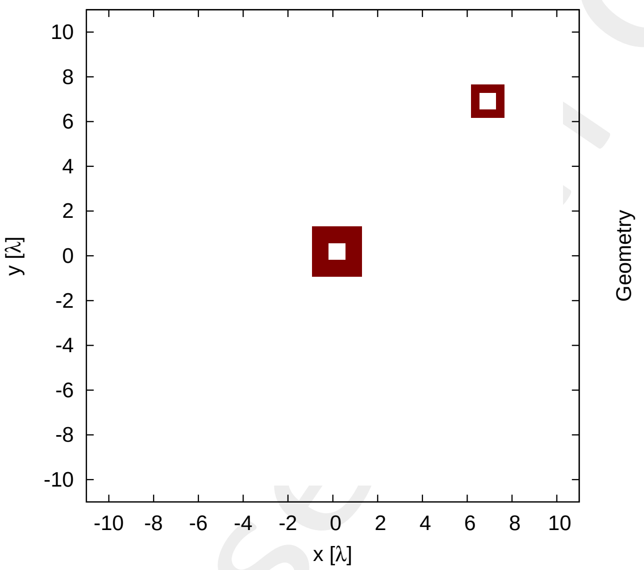
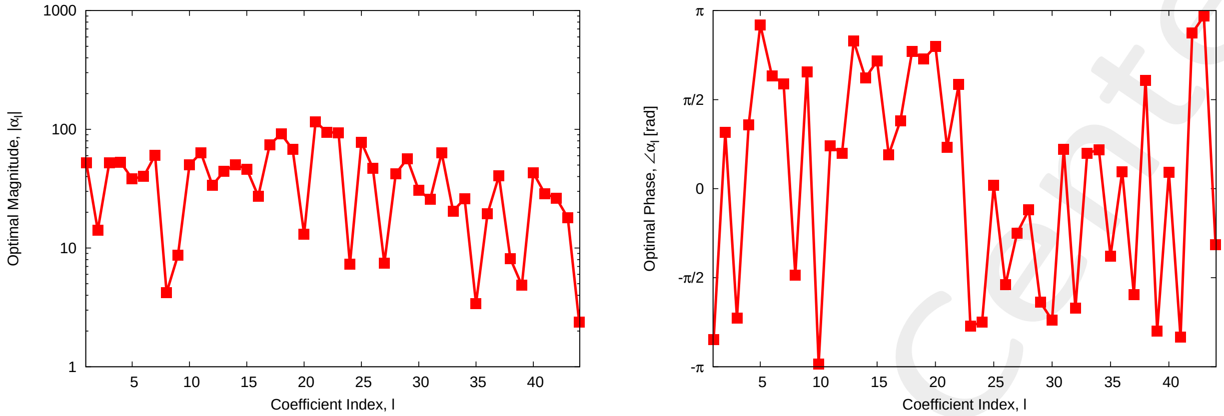


Figure 1: Geometry of the forbidden region Ω.

Results

Magnitude and phase of the *NR* coefficients.



(a) (b)

Figure 2: Magnitude (a) and phase (b) of the solution.

Index q	$\Re\{\alpha_q\}$	$\Im\{\alpha_q\}$	Index q	$\Re\{\alpha_q\}$	$\Im\{\alpha_q\}$	Index q	$\Re\{\alpha_q\}$	$\Im\{\alpha_q\}$
1	-4.61×10^1	-2.42×10^1	16	2.26×10^1	1.54×10^1	31	1.97×10^1	1.65×10^1
2	7.68	1.19×10^1	17	2.69×10^1	6.93×10^1	32	-3.25×10^1	-5.42×10^1
3	-3.39×10^1	-3.95×10^1	18	-6.86×10^1	6.04×10^1	33	1.66×10^1	1.20×10^1
4	2.28×10^1	4.75×10^1	19	-4.42×10^1	5.10×10^1	34	2.01×10^1	1.66×10^1
5	-3.71×10^1	9.54	20	-1.06×10^1	7.72	35	1.28	-3.16
6	-1.63×10^1	3.66×10^1	21	8.63×10^1	7.74×10^1	36	1.86×10^1	5.76
7	-1.67×10^1	5.81×10^1	22	-2.46×10^1	9.11×10^1	37	-1.18×10^1	-3.87×10^1
8	1.98×10^{-1}	-4.21	23	-7.05×10^1	-6.18×10^1	38	-2.73	7.62
9	-4.10	7.72	24	-5.16	-5.19	39	-3.91	-2.87
10	-5.03×10^1	-2.62	25	7.77×10^1	4.61	40	4.12×10^1	1.21×10^1
11	4.62×10^1	4.33×10^1	26	-5.89	-4.67×10^1	41	-2.49×10^1	-1.42×10^1
12	2.75×10^1	1.97×10^1	27	5.27	-5.26	42	-2.43×10^1	1.02×10^1
13	-3.79×10^1	2.27×10^1	28	3.94×10^1	-1.55×10^1	43	-1.79×10^1	1.75
14	-1.88×10^1	4.68×10^1	29	-2.38×10^1	-5.12×10^1	44	1.30	-1.98
15	-2.91×10^1	3.60×10^1	30	-2.08×10^1	-2.24×10^1			

Table I: Solution of the linear system

Currents Distribution

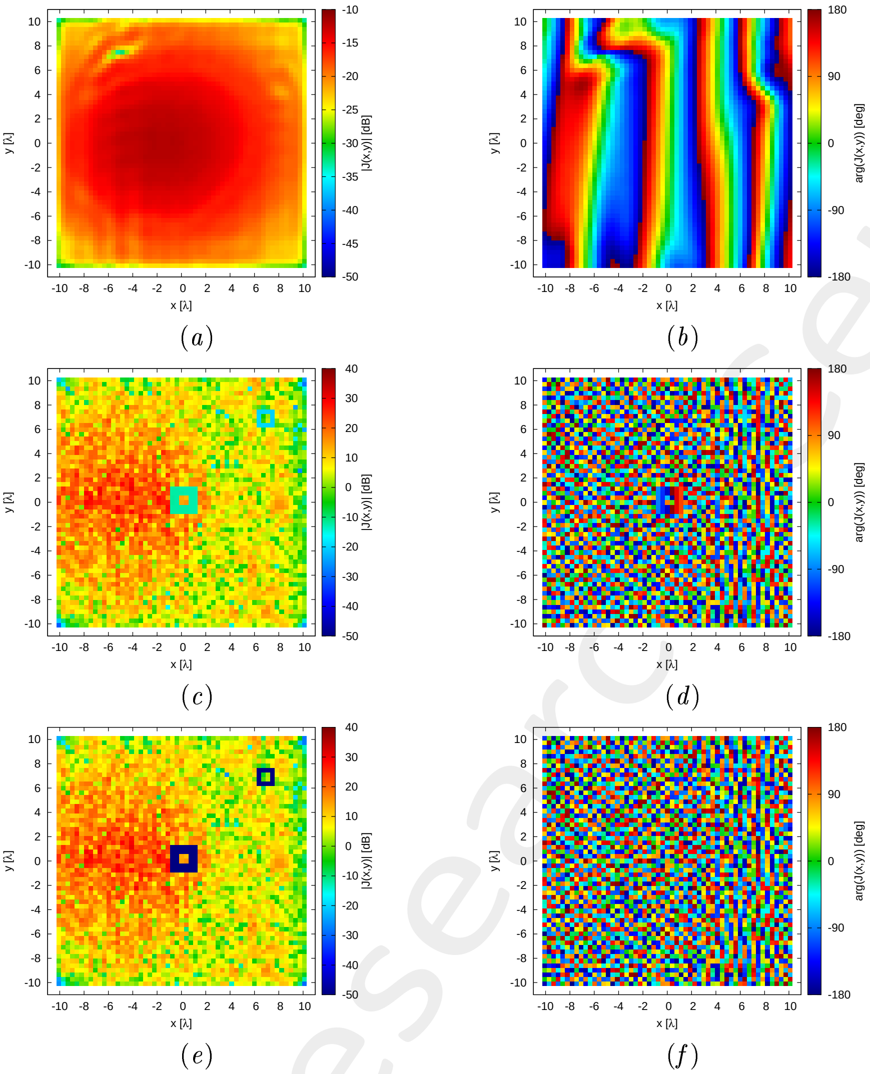


Figure 3: $(a)(c)(e)$ Magnitude and $(b)(d)(f)$ phase $(a)(b)$ of $J^{MN}(x,y)$, $(c)(d)$ $J^{NR}(x,y;\underline{\alpha})$, and $(e)(f)$ $J^{TOT}(x,y;\underline{\alpha})$.

Radiated Field

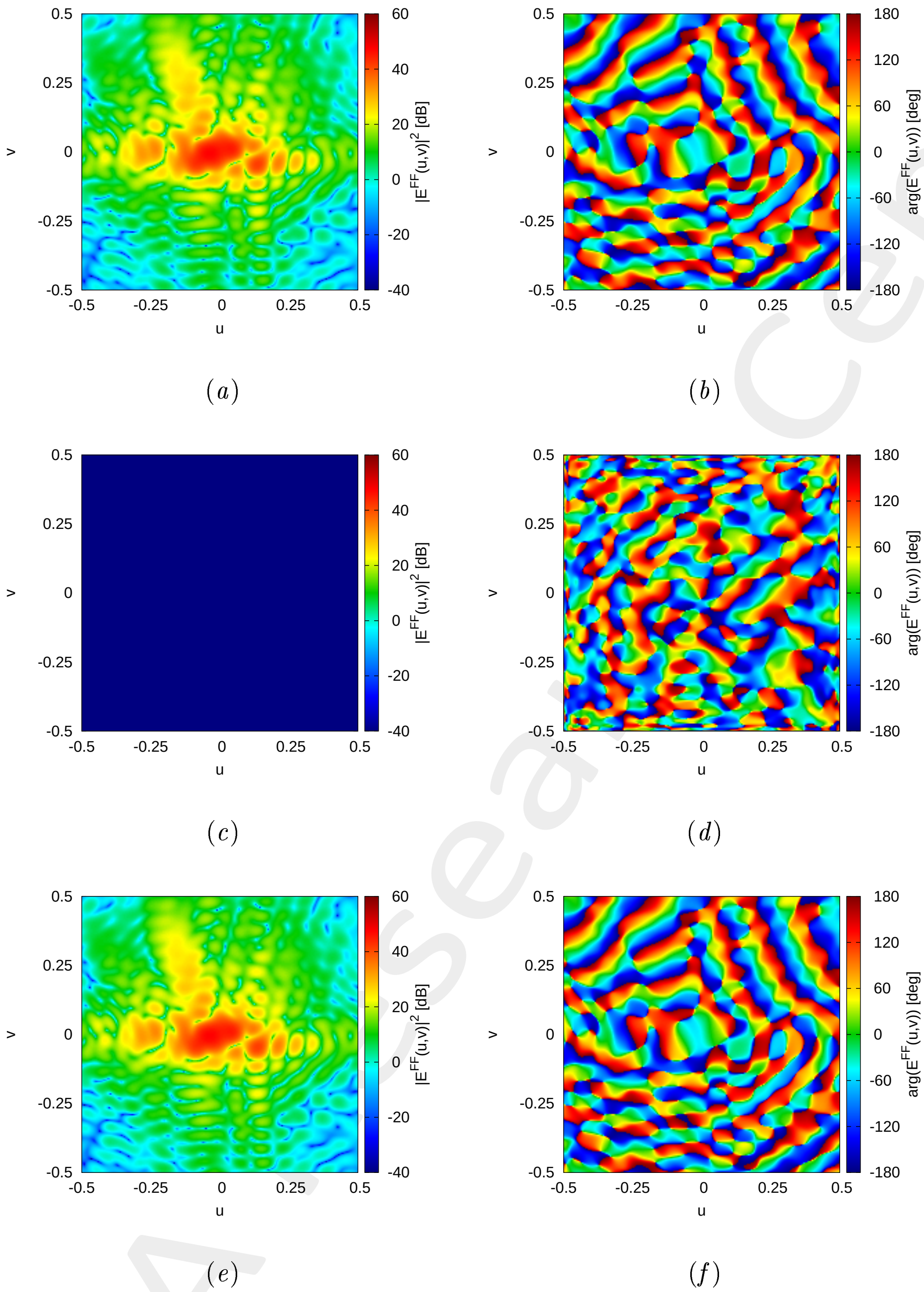


Figure 4: $(a)(c)(e)$ Magnitude and $(b)(d)(f)$ phase of the radiated field by $(a)(b)$, $J^{MN}(x,y)$, $(c)(d)$ $J^{NR}(x,y;\underline{\alpha})$, and $(e)(f)$ $J^{TOT}(x,y;\underline{\alpha})$.

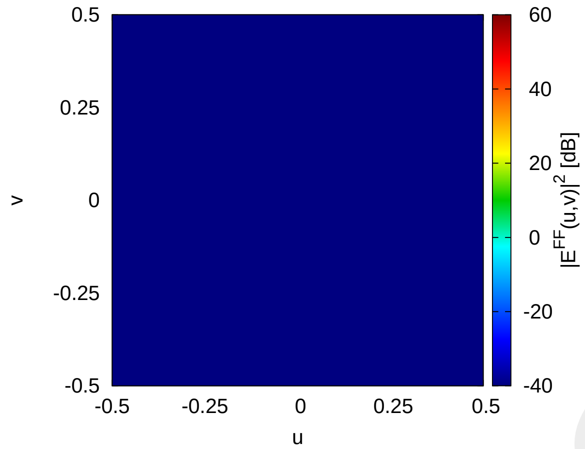


Figure 5: Magnitude of the difference between the radiated fields by $J^{MN}(x,y)$ and $J^{TOT}(x,y;\underline{\alpha})$.

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