

Supplementary Information

EMC Impact of Disturbances Generated by Multiple Sources

Contents of this file

The supplementary information contains 10 figures and 8 tables.

Figures

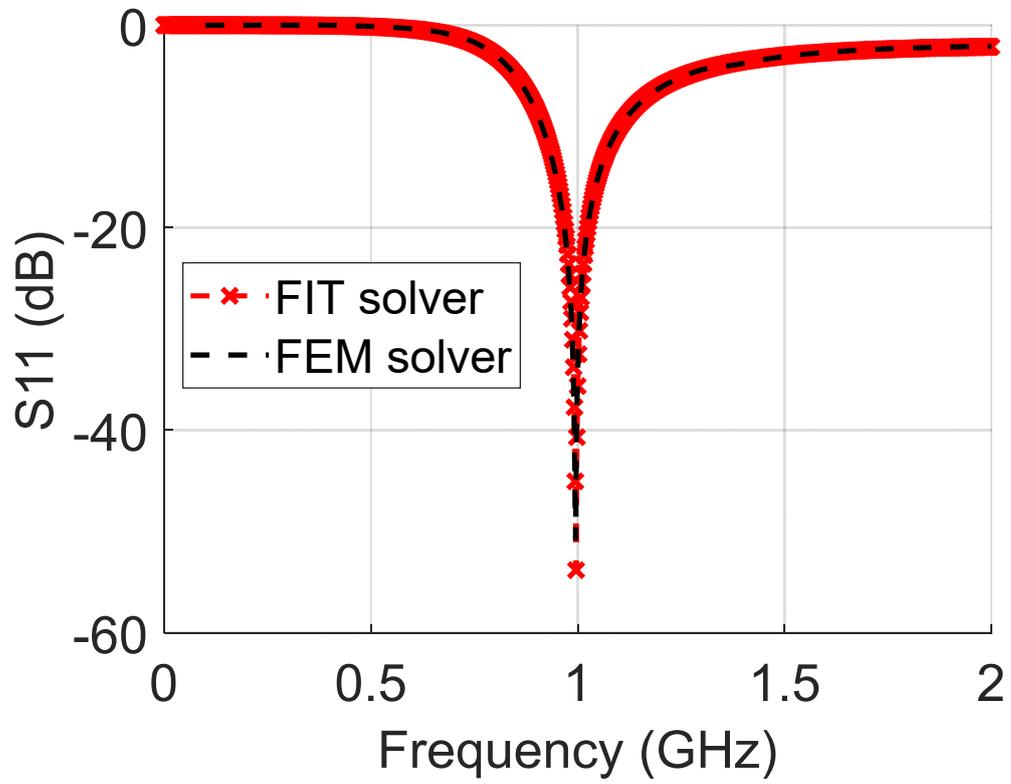


Fig. S1. The dipole antenna scattering parameter S11 calculated by way of the CST-MWS software using both the time-domain Finite Integration Technique (FIT) and the Finite Element Method (FEM).

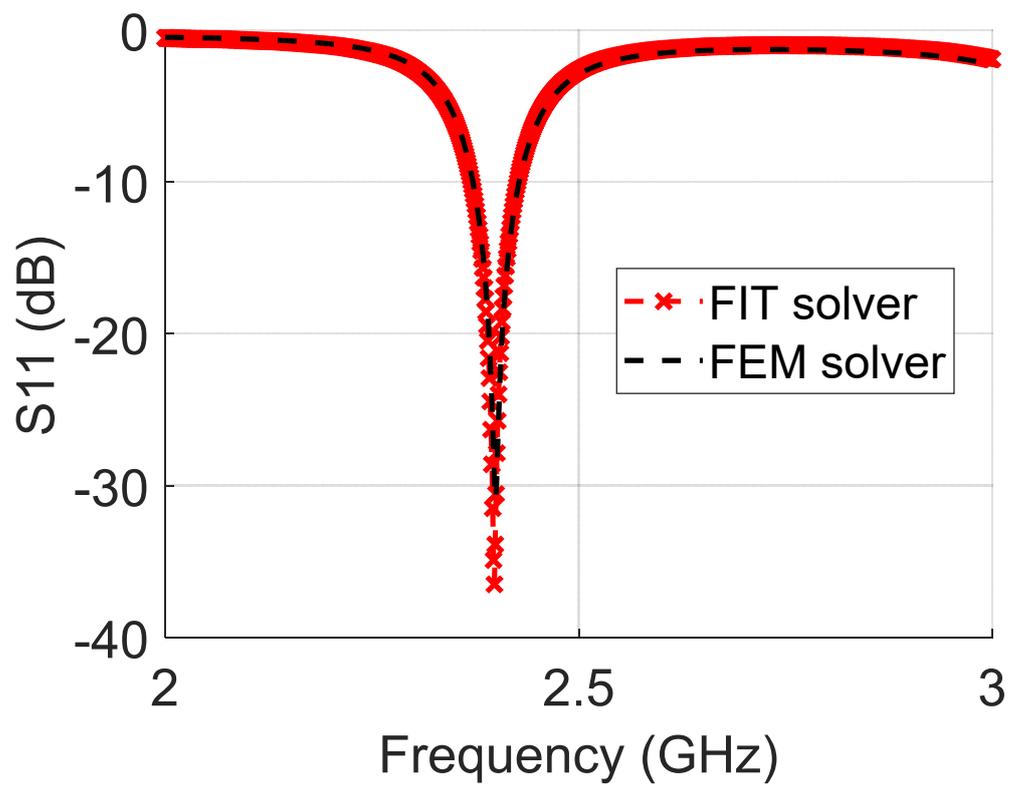


Fig. S2. The microstrip antenna scattering parameter S11 calculated by CST-MWS using both the time-domain FIT and the frequency domain FEM.

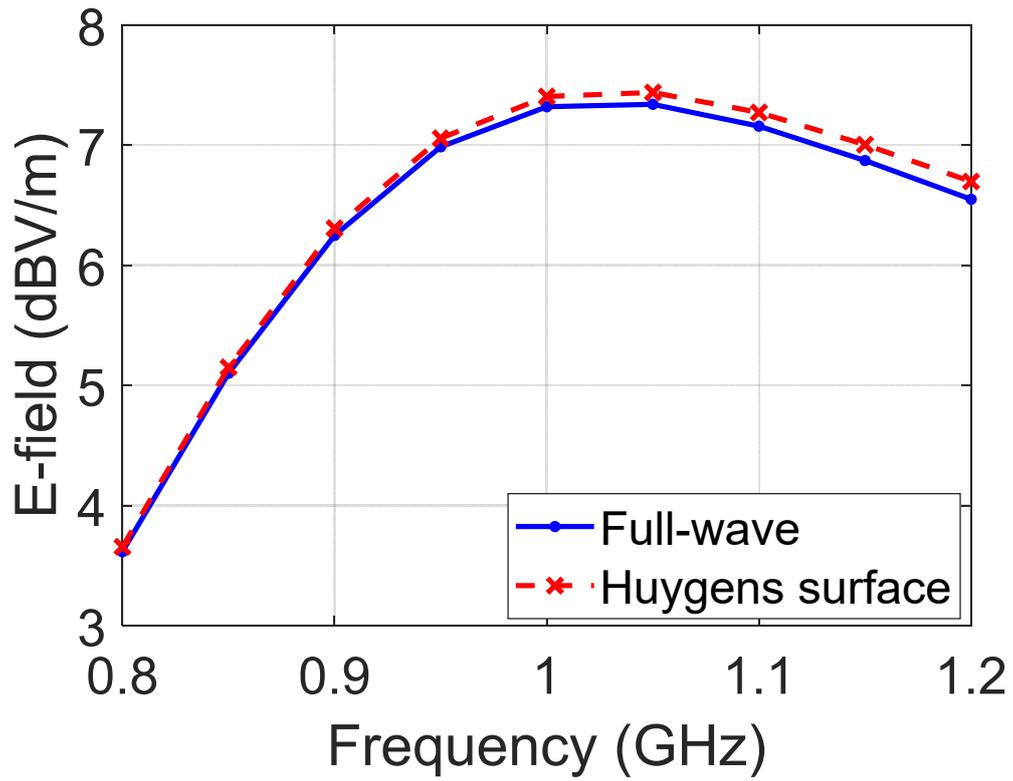


Fig. S3. The radiated electric field of the dipole antenna shown in Figure 2(a) at a distance of 3 m along the z-axis from the center of the dipole antenna. Comparison between the full-wave approach and the Huygens surface approach.

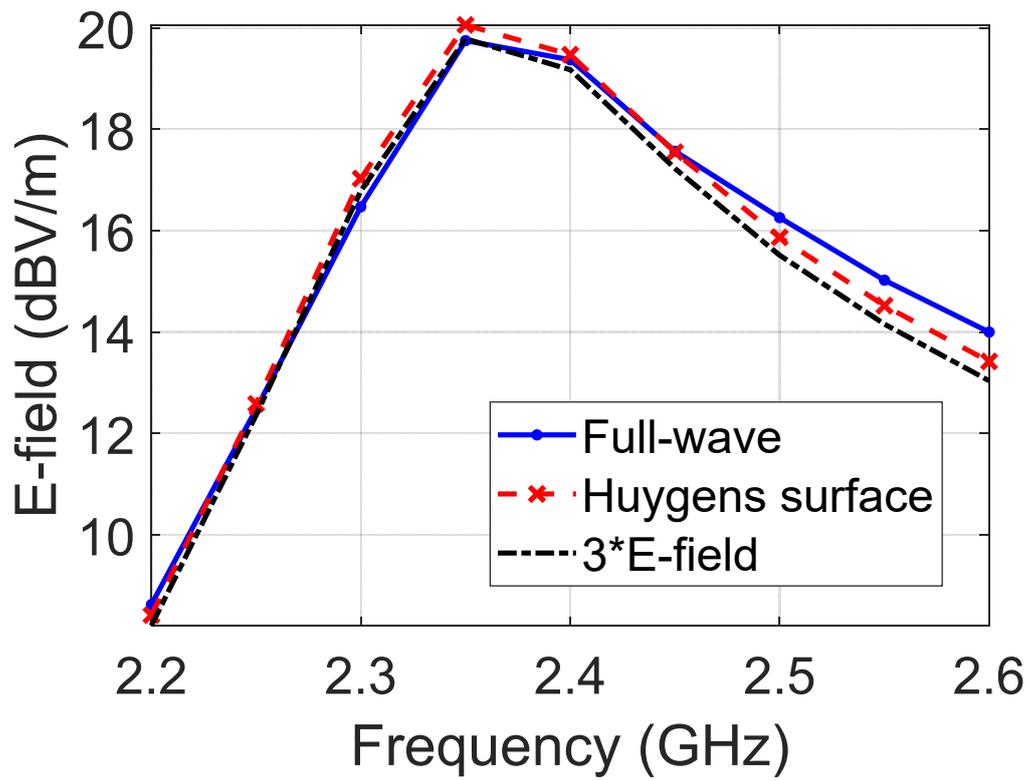


Fig. S4. The radiated electric field of the three microstrip antennas shown in Figure 7. The distances between the EMI sources and the observation point are 1.5 m.

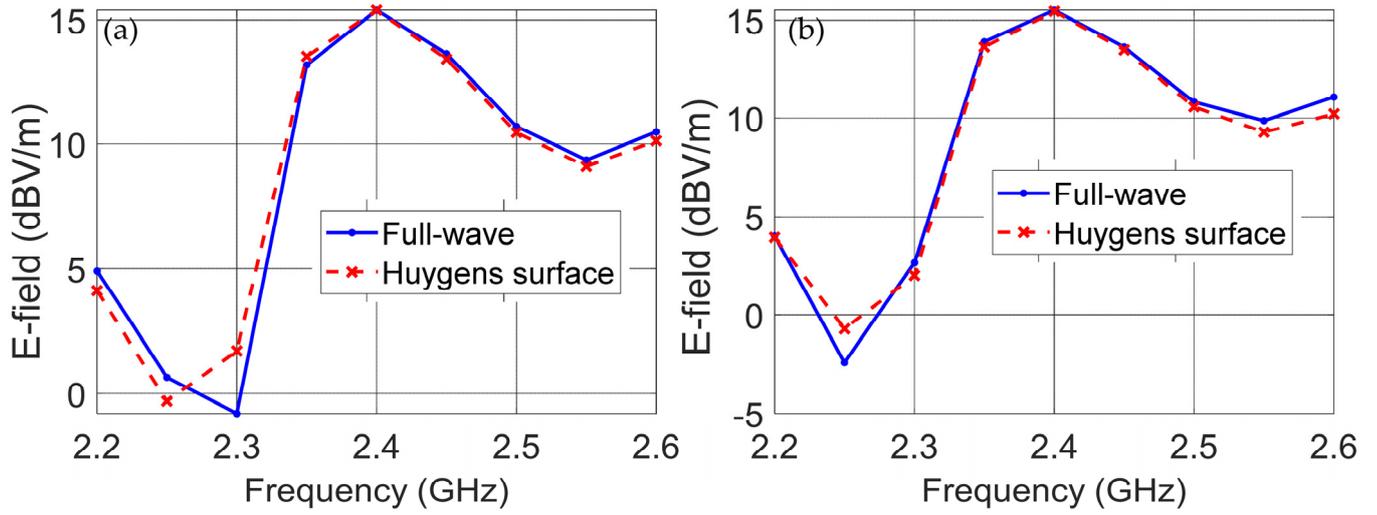


Fig. S5. The radiated electric field from the three microstrip antennas shown in Figure 7. (a) Observation point at (0.5, 0, 0). (b) Observation point at (-0.5, 0, 0).

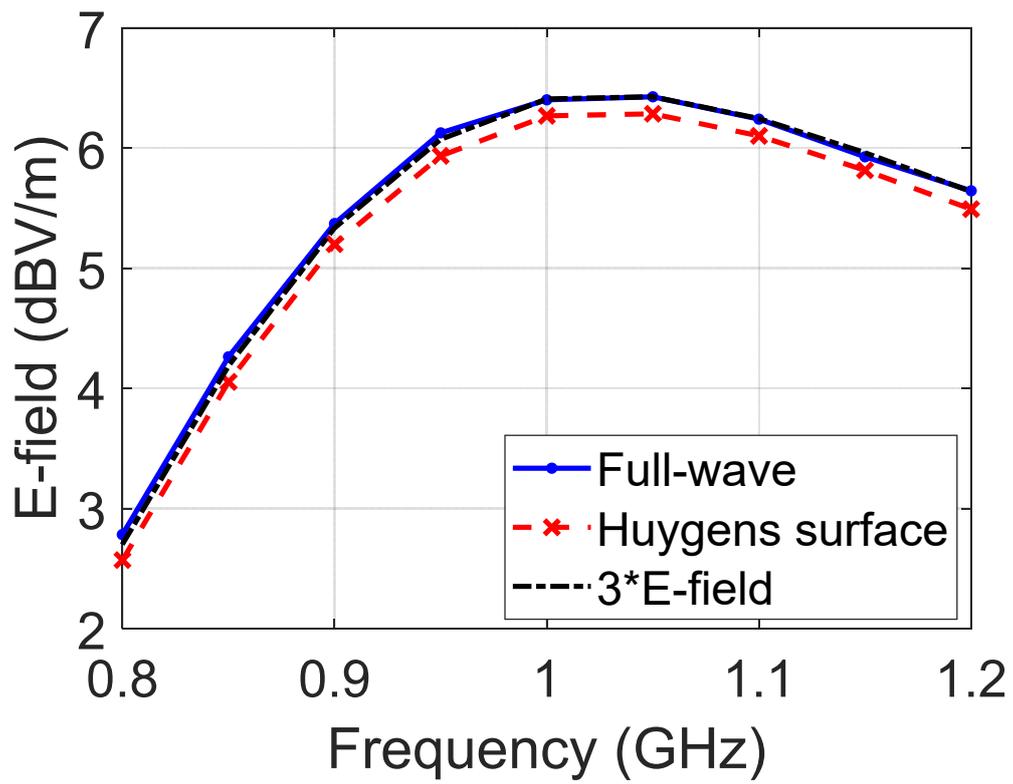
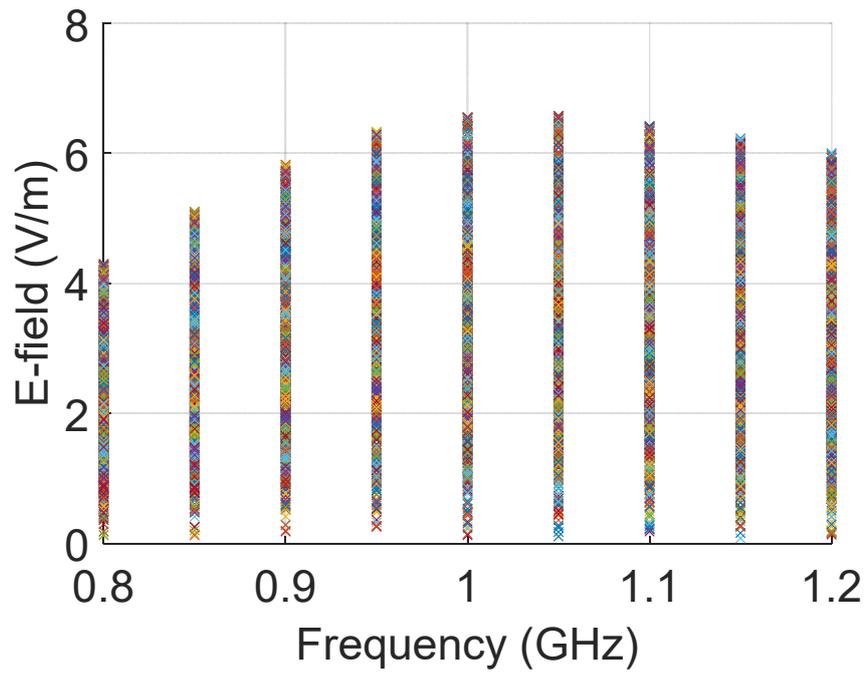
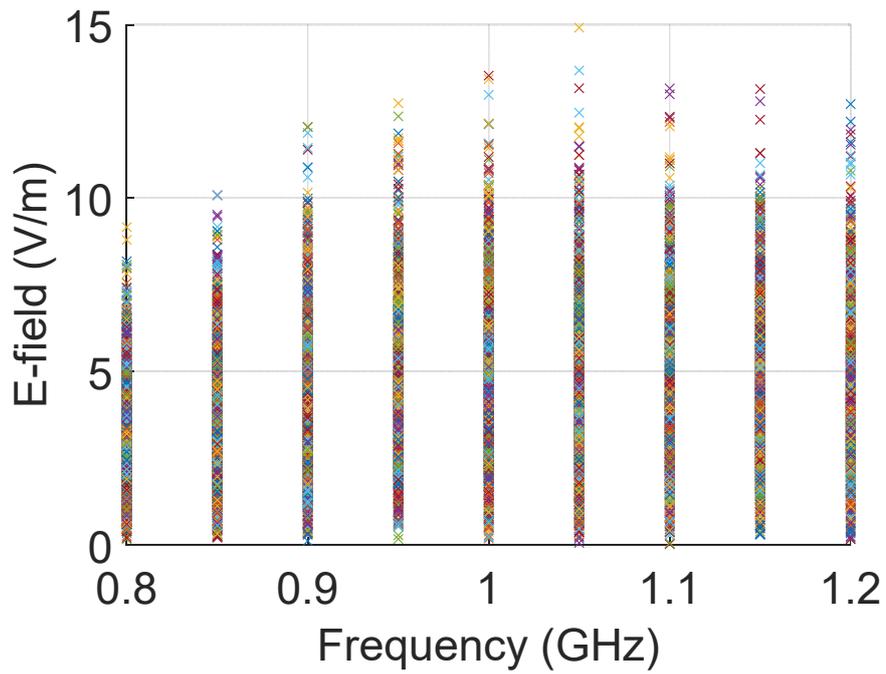


Fig. S6. The radiated electric field of three dipole antennas in the same configuration as in Figure 7. The distance between the observation point and each EMI source is 10 m.

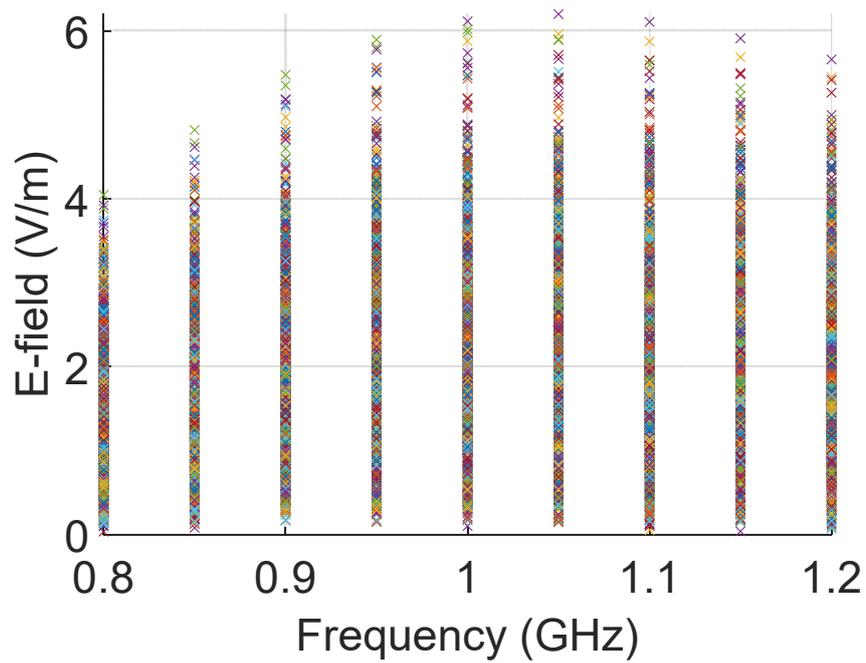


(a)

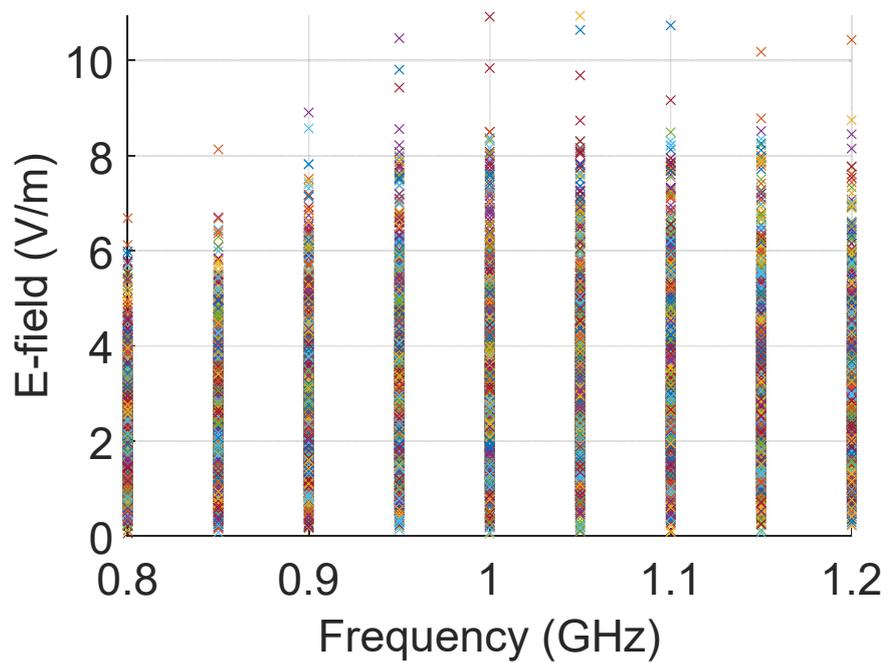


(b)

Fig. S7. The radiated emission from multiple devices *with random phase* in the frequency range from 0.8 to 1.2 GHz for 1000 Monte-Carlo simulations. (a) For 3 devices, (b) For 9 devices.



(a)



(b)

Fig. S8. The radiated emission from multiple devices *with random phase and orientation* in the frequency range from 0.8 to 1.2 GHz for 1000 Monte-Carlo simulations. (a) For 3 devices, (b) For 9 devices.

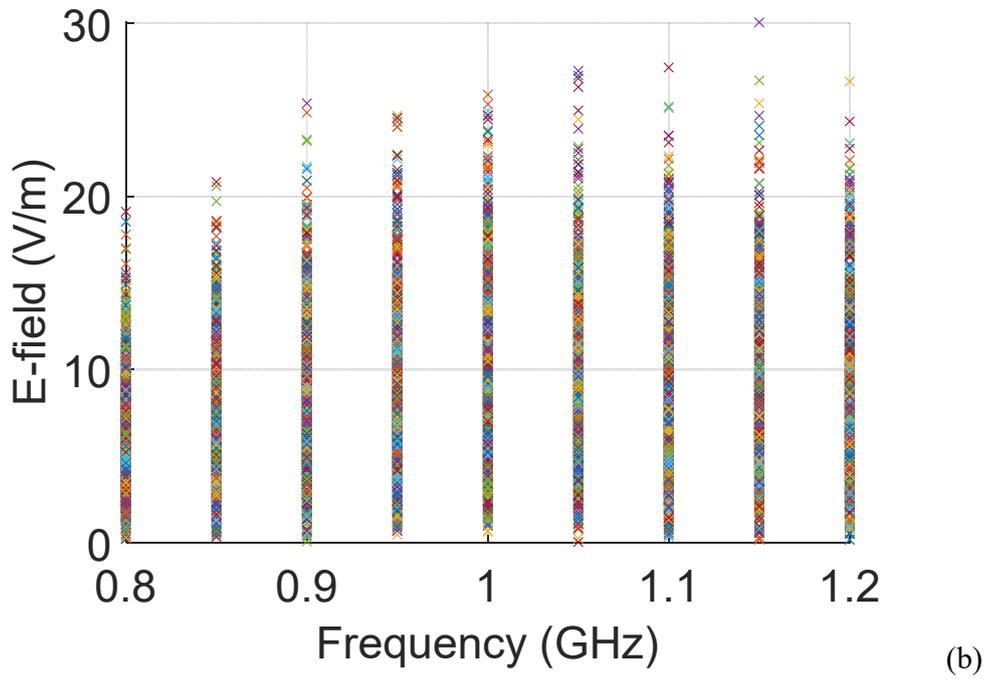
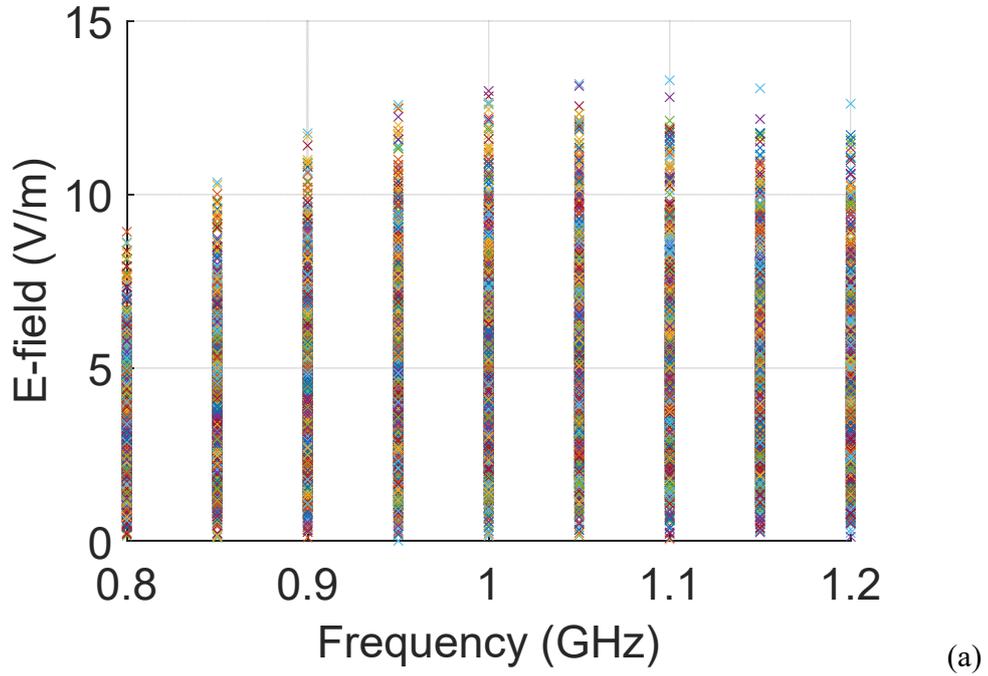


Fig. S9. The radiated emission from multiple devices configured in a two-dimensional array *with random phase* in the frequency range from 0.8 to 1.2 GHz for 1000 Monte-Carlo simulations. (a) For 3×3 devices, (b) For 9×9 devices.

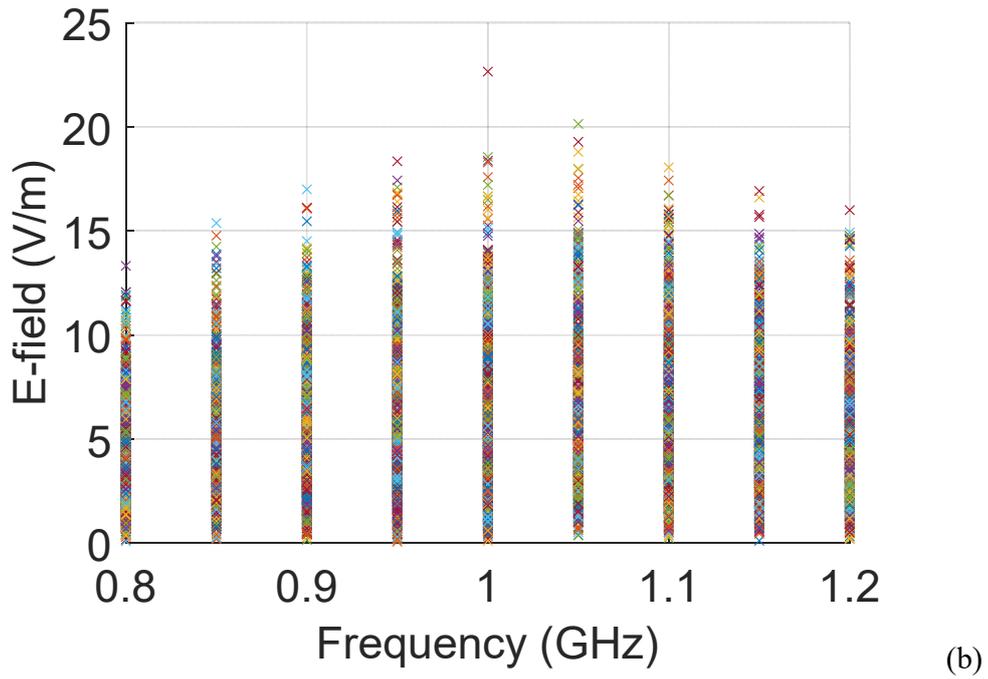
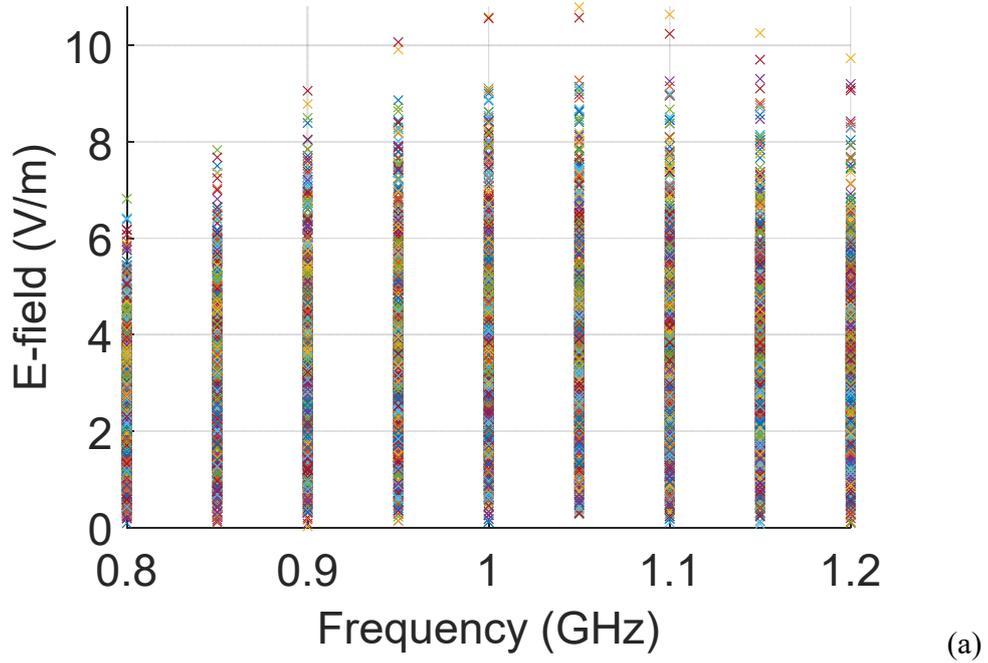


Fig. S10. The radiated emission from multiple devices configured in a two-dimensional array *with random phase and orientation* in the frequency range from 0.8 to 1.2 GHz for 1000 Monte-Carlo simulations. (a) For 3×3 devices, (b) For 7×7 devices.

Tables

Table S1. The radiated emission from a linear array of EMI sources at a minimum distance of 3 m from the devices at 0.8 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3 devices	1.59	Mean: 2.24 Std: 0.99	Mean: 1.50 Std: 0.75
5 devices	2.98	Mean: 2.73 Std: 1.36	Mean: 1.84 Std: 0.98
7 devices	4.05	Mean: 3.18 Std: 1.56	Mean: 2.06 Std: 1.03
9 devices	5.57	Mean: 3.28 Std: 1.65	Mean: 2.21 Std: 1.15

Table S2. The radiated emission from a linear array of EMI sources at a minimum distance of 3 m from the devices at 0.9 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3 devices	1.82	Mean: 3.00 Std: 1.33	Mean: 2.19 Std: 1.12
5 devices	2.78	Mean: 3.67 Std: 1.83	Mean: 2.50 Std: 1.33
7 devices	5.61	Mean: 4.19 Std: 2.06	Mean: 2.83 Std: 1.45
9 devices	5.76	Mean: 4.42 Std: 2.23	Mean: 3.01 Std: 1.54

Table S3. The radiated emission from a linear array of EMI sources at a minimum distance of 3 m from the devices at 1.1 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3 devices	2.69	Mean: 3.26 Std: 1.51	Mean: 2.02 Std: 1.04
5 devices	1.40	Mean: 4.02 Std: 2.03	Mean: 2.65 Std: 1.33
7 devices	3.52	Mean: 4.46 Std: 2.31	Mean: 2.93 Std: 1.53
9 devices	5.49	Mean: 4.75 Std: 3.38	Mean: 3.28 Std: 1.75

Table S4. The radiated emission from a linear array of EMI sources at a minimum distance of 3 m from the devices at 1.2 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3 devices	3.18	Mean: 3.03 Std: 1.43	Mean: 2.02 Std: 1.04
5 devices	3.67	Mean: 3.77 Std: 1.88	Mean: 2.44 Std: 1.21
7 devices	2.11	Mean: 4.15 Std: 2.11	Mean: 2.75 Std: 1.39
9 devices	2.87	Mean: 4.45 Std: 2.29	Mean: 3.07 Std: 1.57

Table S5. The radiated emission from a two-dimensional linear array of EMI sources at a minimum distance of 3 m from the devices at 0.8 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3×3 devices	1.95	Mean: 3.49 Std: 1.73	Mean: 2.46 Std: 1.27
5×5 devices	9.18	Mean: 4.92 Std: 2.62	Mean: 3.55 Std: 1.83
7×7 devices	4.05	Mean: 5.78 Std: 2.99	Mean: 4.32 Std: 2.31
9×9 devices	13.71	Mean: 6.46 Std: 3.23	--- ---

Table S6. The radiated emission from a two-dimensional linear array of EMI sources at a minimum distance of 3 m from the devices at 0.9 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3×3 devices	1.77	Mean: 4.66 Std: 2.31	Mean: 3.28 Std: 1.69
5×5 devices	7.17	Mean: 6.60 Std: 3.40	Mean: 4.88 Std: 2.56
7×7 devices	5.62	Mean: 7.82 Std: 3.95	Mean: 5.86 Std: 3.04
9×9 devices	23.90	Mean: 8.74 Std: 4.43	--- ---

Table S7. The radiated emission from a two-dimensional linear array of EMI sources at a minimum distance of 3 m from the devices at 1.1 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3×3 devices	1.68	Mean: 5.06 Std: 2.54	Mean: 3.54 Std: 1.82
5×5 devices	1.90	Mean: 7.29 Std: 3.8	Mean: 5.23 Std: 2.70
7×7 devices	3.53	Mean: 8.59 Std: 4.47	Mean: 6.34 Std: 3.35
9×9 devices	1.33	Mean: 9.18 Std: 4.85	--- ---

Table S8. The radiated emission from a two-dimensional linear array of EMI sources at a minimum distance of 3 m from the devices at 1.2 GHz. The radiated emissions for the correlated case study are given for comparison purposes in the first column.

	Radiated emission for correlated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices (V/m)	Mean and std of the radiated emission for uncorrelated devices with random orientation (V/m)
Single EUT	2.28	---	---
3×3 devices	3.03	Mean: 4.70 Std: 2.41	Mean: 3.26 Std: 1.68
5×5 devices	2.45	Mean: 6.69 Std: 3.46	Mean: 4.76 Std: 2.45
7×7 devices	2.11	Mean: 8.00 Std: 4.07	Mean: 5.71 Std: 2.97
9×9 devices	14.85	Mean: 8.62 Std: 4.62	--- ---