Power Pattern Matching-Based Design of Clustered Phased Arrays: A Novel Method for Linear Arrays

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1 Numerical Results

1.1 Taylor, $\mathrm{SLL} = -30$ [dB], $\overline{\mathrm{n}} = 7$, $\theta_s = -10$ [deg]

1.1.1 $\mathrm{N} = 16$ – $\mathrm{Q} = \mathrm{N}/2$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 16$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 8$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

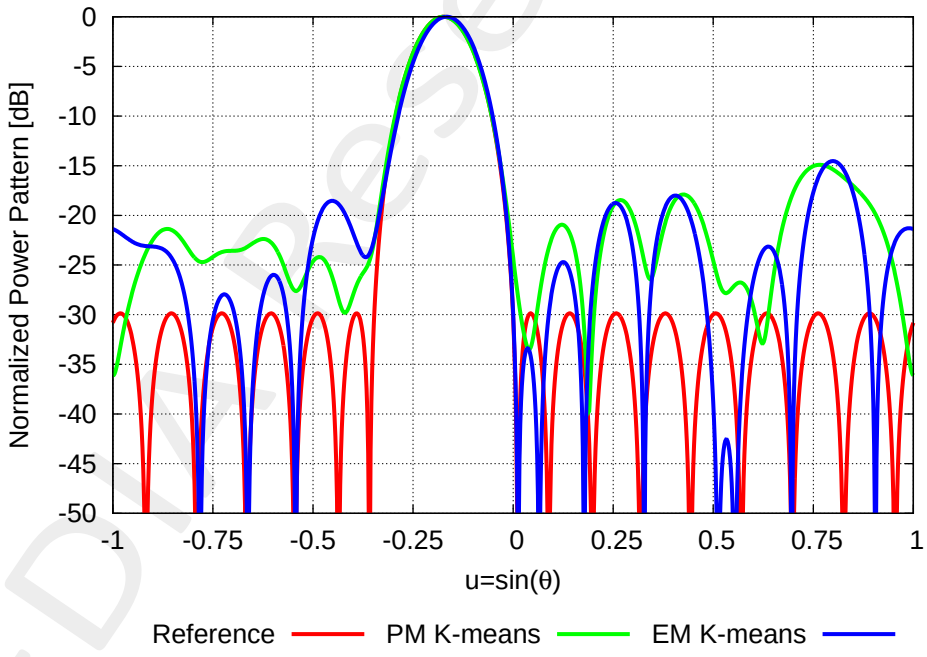


Figure 1: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	8.46×10^{-2}
EM K-means	1.48×10^{-1}

Table I: Pattern Matching

1.1.2 $\mathbf{N = 32 \ - \ Q = N/2}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 32$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 16$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

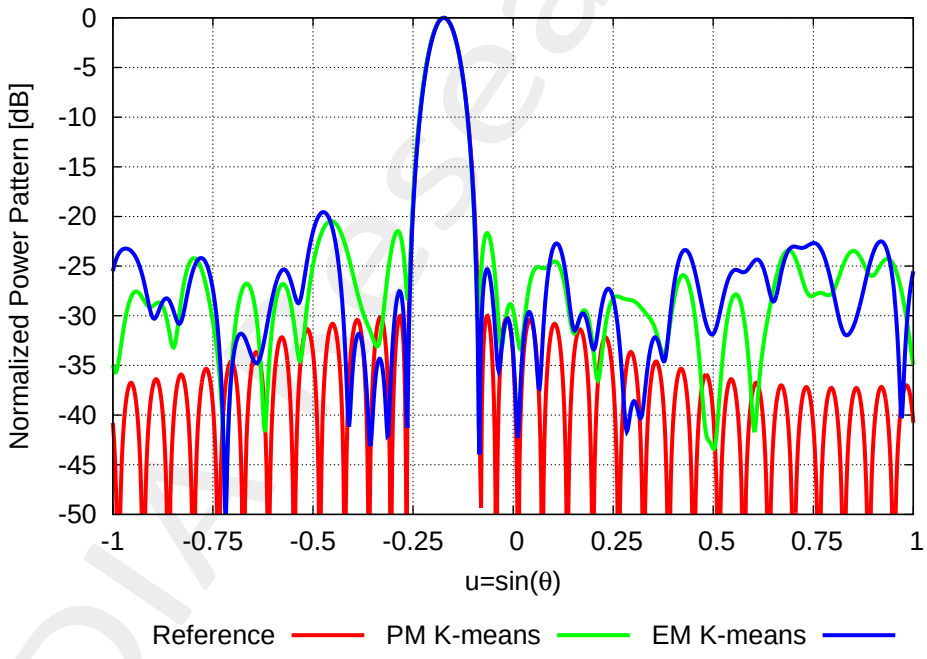


Figure 2: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	5.34×10^{-2}
EM K-means	6.67×10^{-2}

Table II: Pattern Matching

1.1.3 $\mathbf{N = 48 \ - \ Q = N/2}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 48$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 24$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

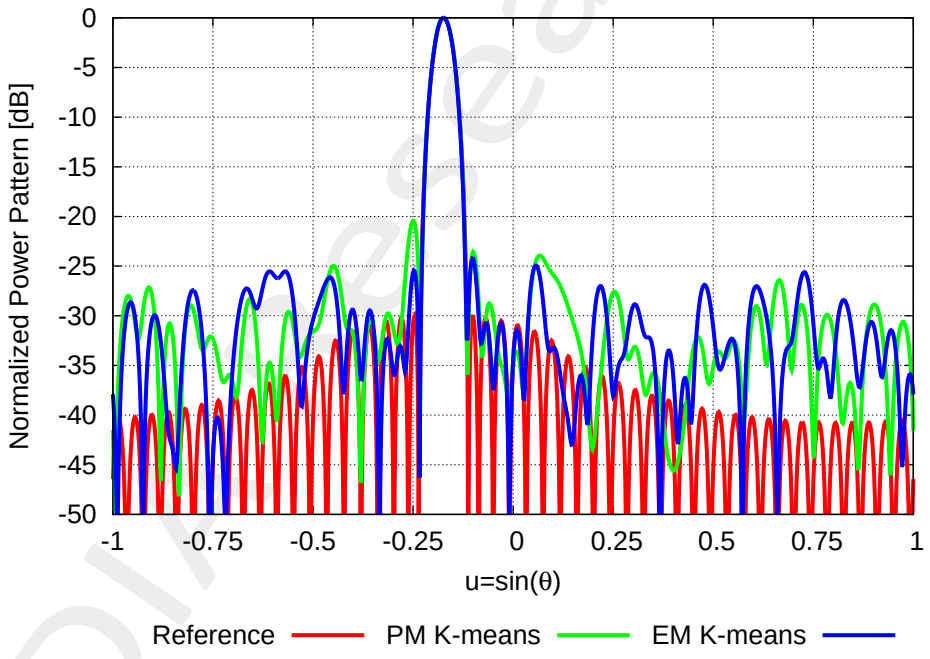


Figure 3: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	3.56×10^{-2}
EM K-means	3.59×10^{-2}

Table III: Pattern Matching

1.1.4 $\mathbf{N = 64 \ - \ Q = N/2}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 64$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 32$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

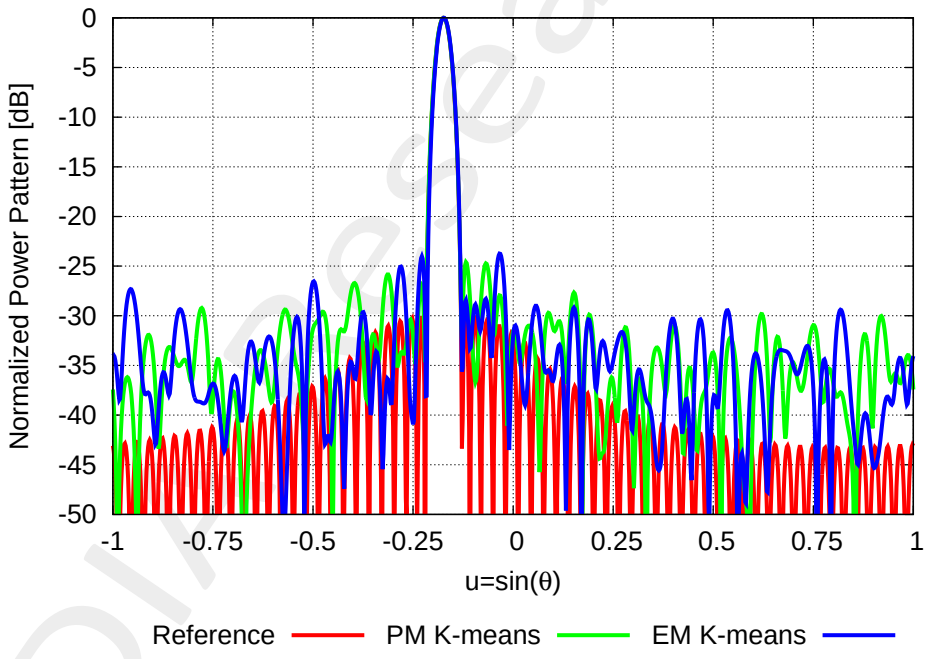


Figure 4: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	3.12×10^{-2}
EM K-means	5.70×10^{-2}

Table IV: Pattern Matching

1.1.5 $\mathbf{N = 96 \ - \ Q = N/2}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 96$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 48$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

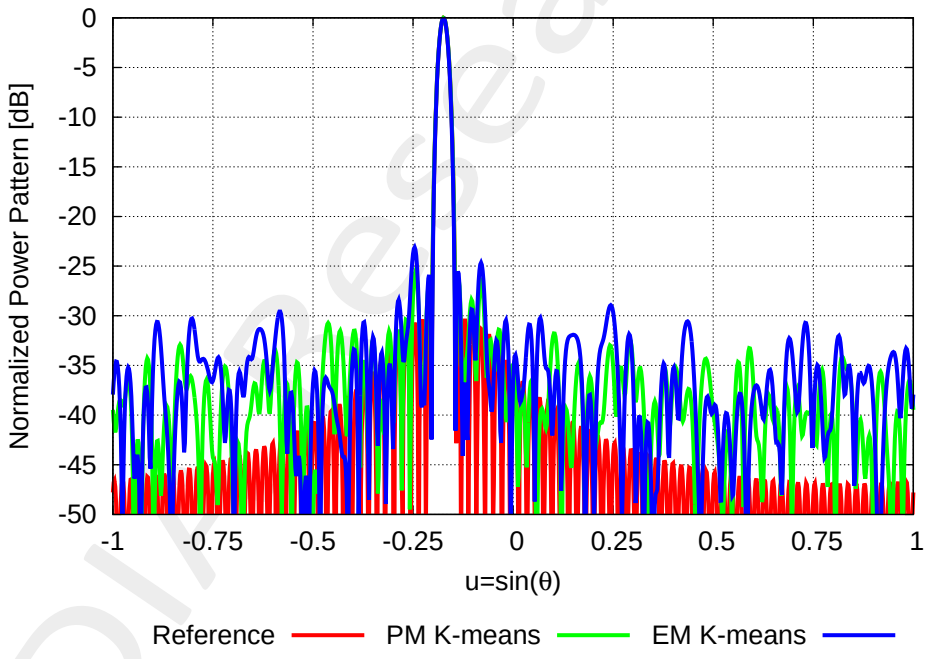


Figure 5: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	2.16×10^{-2}
EM K-means	4.02×10^{-2}

Table V: Pattern Matching

1.1.6 $\mathbf{N = 128 \ - \ Q = N/2}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 128$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 64$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

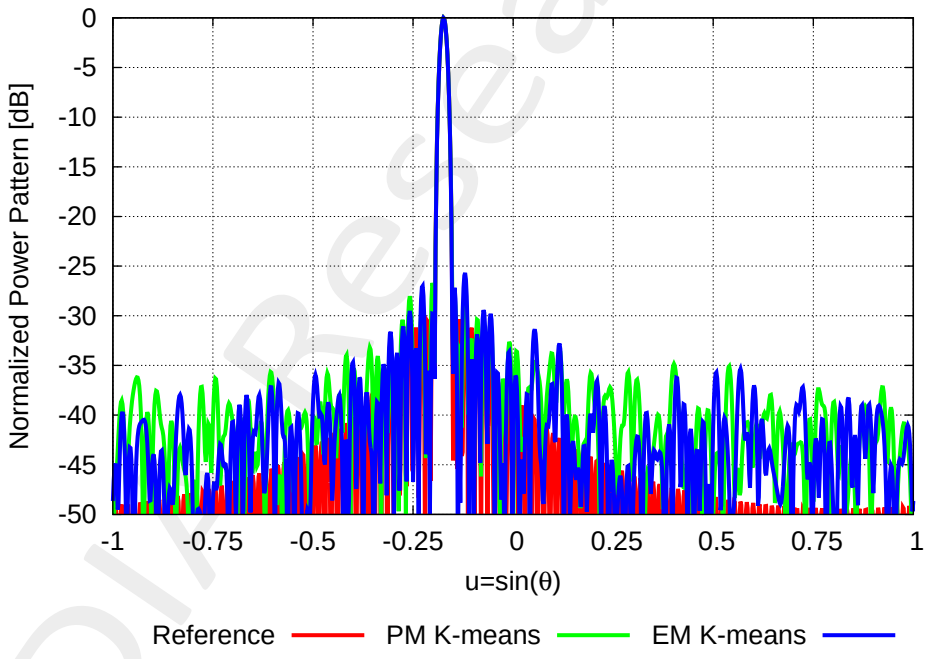


Figure 6: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	1.48×10^{-2}
EM K-means	1.72×10^{-2}

Table VI: Pattern Matching

1.1.7 $\mathbf{N = 16 \ - \ Q = \frac{3}{4}N}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 16$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 12$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

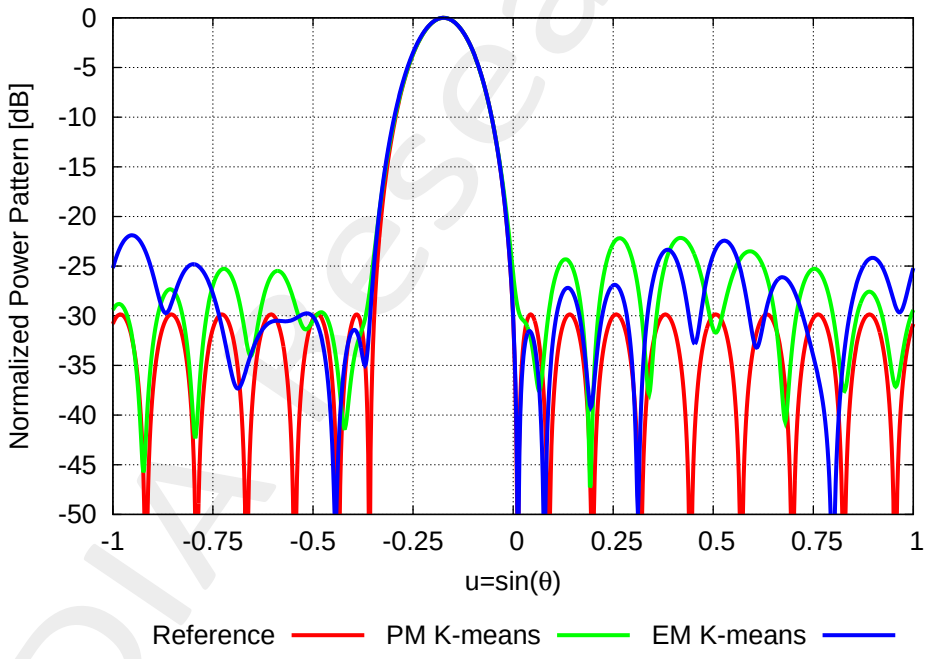


Figure 7: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	1.98×10^{-2}
EM K-means	2.36×10^{-2}

Table VII: Pattern Matching

1.1.8 $\mathbf{N = 32 \; - \; Q = \frac{3}{4}N}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 32$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 24$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

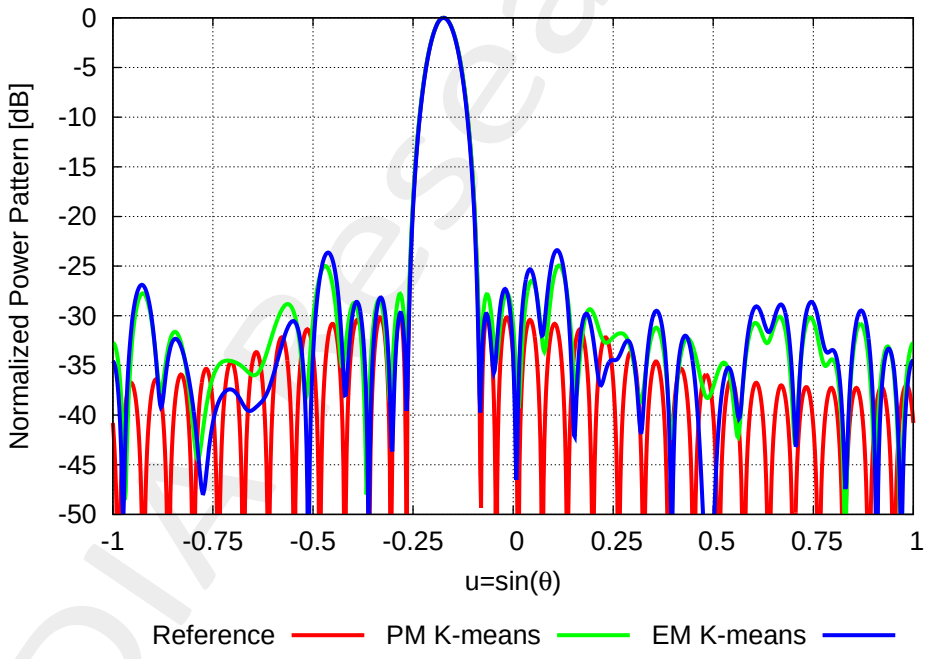


Figure 8: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	1.79×10^{-2}
EM K-means	3.85×10^{-2}

Table VIII: Pattern Matching

1.1.9 $\mathbf{N = 48 \; - \; Q = \frac{3}{4}N}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 48$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 36$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

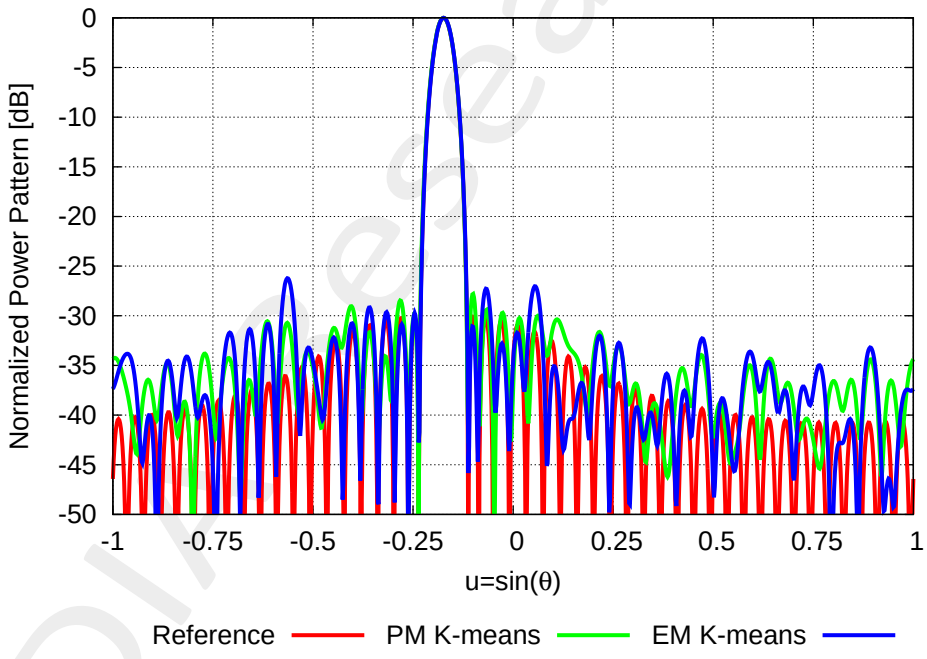


Figure 9: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	1.51×10^{-2}
EM K-means	2.15×10^{-2}

Table IX: Pattern Matching

1.1.10 $\mathbf{N = 64 \; - \; Q = \frac{3}{4}N}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 64$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 48$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

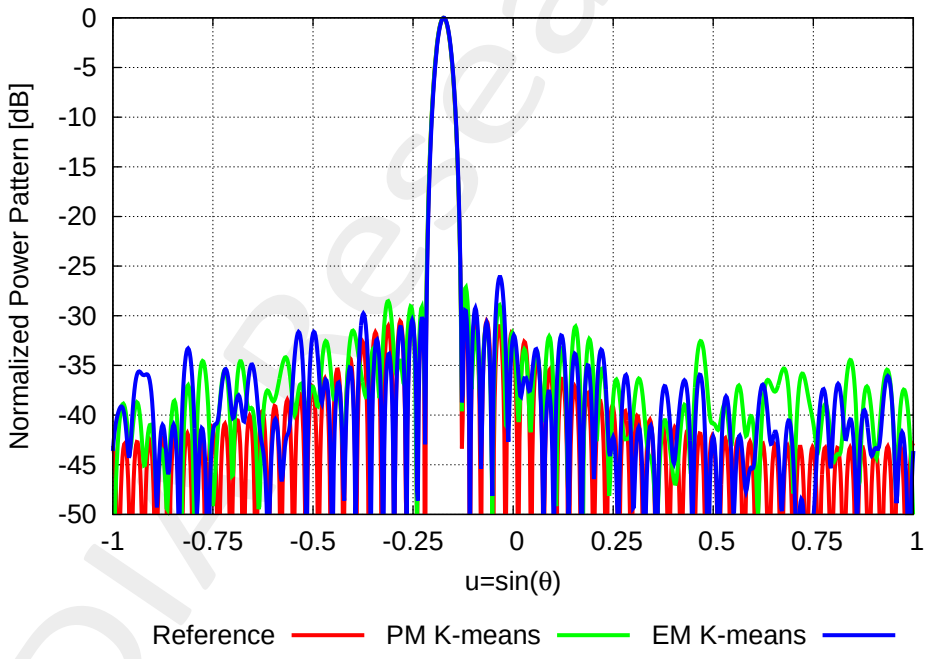


Figure 10: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	1.22×10^{-2}
EM K-means	3.65×10^{-2}

Table X: Pattern Matching

1.1.11 $\mathbf{N = 96 \ - \ Q = \frac{3}{4}N}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 96$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 72$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

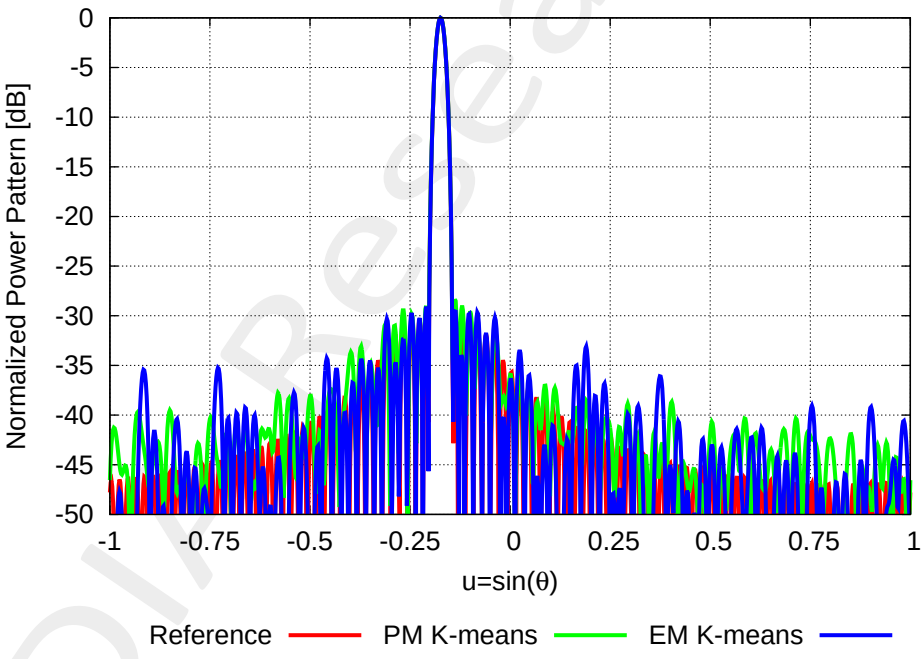


Figure 11: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	9.12×10^{-3}
EM K-means	9.50×10^{-3}

Table XI: Pattern Matching

1.1.12 $\mathbf{N = 128 - Q = \frac{3}{4}N}$

Antenna configuration

- Isotropic Elements
- Number of Elements: $N = 128$
- Distance between Elements along x axis: $d_x = \lambda/2$

Target excitations

- Main Lobe Steering: $\theta_s = -10$ [deg]
- Taylor, $SLL = -30$ [dB], $\overline{n} = 7$

Sub-array generation

- number of clusters: $Q = 96$
- excitation matching strategy: EM K-Means
- power matching strategy: PM K-means

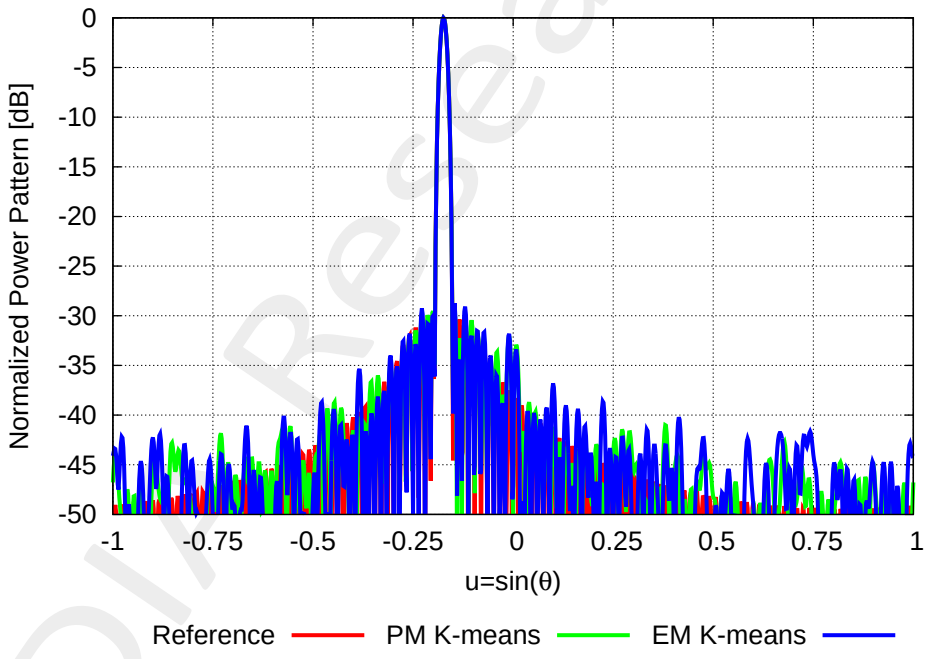


Figure 12: Power Pattern comparison PM K-means vs. EM K-means

Approach	Pattern Matching
PM K-means	5.87×10^{-3}
EM K-means	5.95×10^{-3}

Table XII: Pattern Matching

1.1.13 Pattern Matching Improvement vs. Q/N

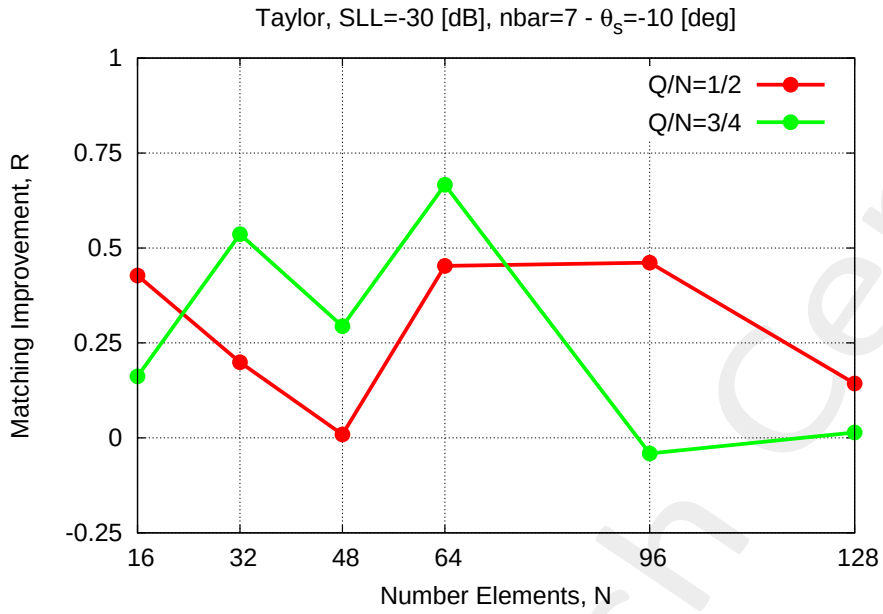
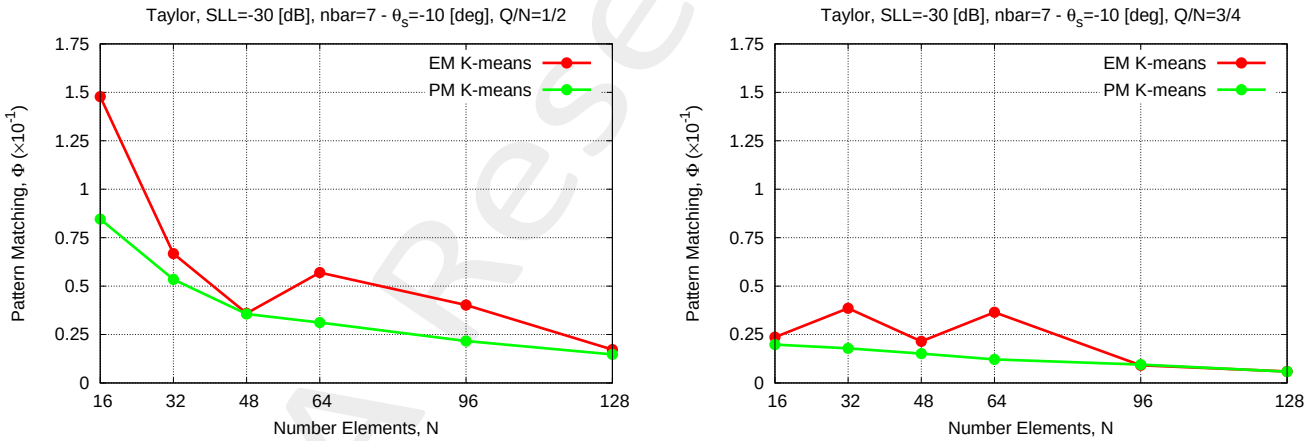


Figure 13: Analysis Matching Improvement vs. Number Elements for different Q/N

1.1.14 Pattern Matching vs. N



(*a*) (*b*)

Figure 14: Pattern Matching comparison PM K-means vs. EM K-means varying the number of elements for (*a*) $Q/N = 1/2$ and (*b*) $Q/N = 3/4$

More information on the topics of this document can be found in the following list of references.

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