Optimal algorithm for phase shift searching for the DPSBF

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Outline

1 Introduction

2 Phase shift searching

3 Conclusion

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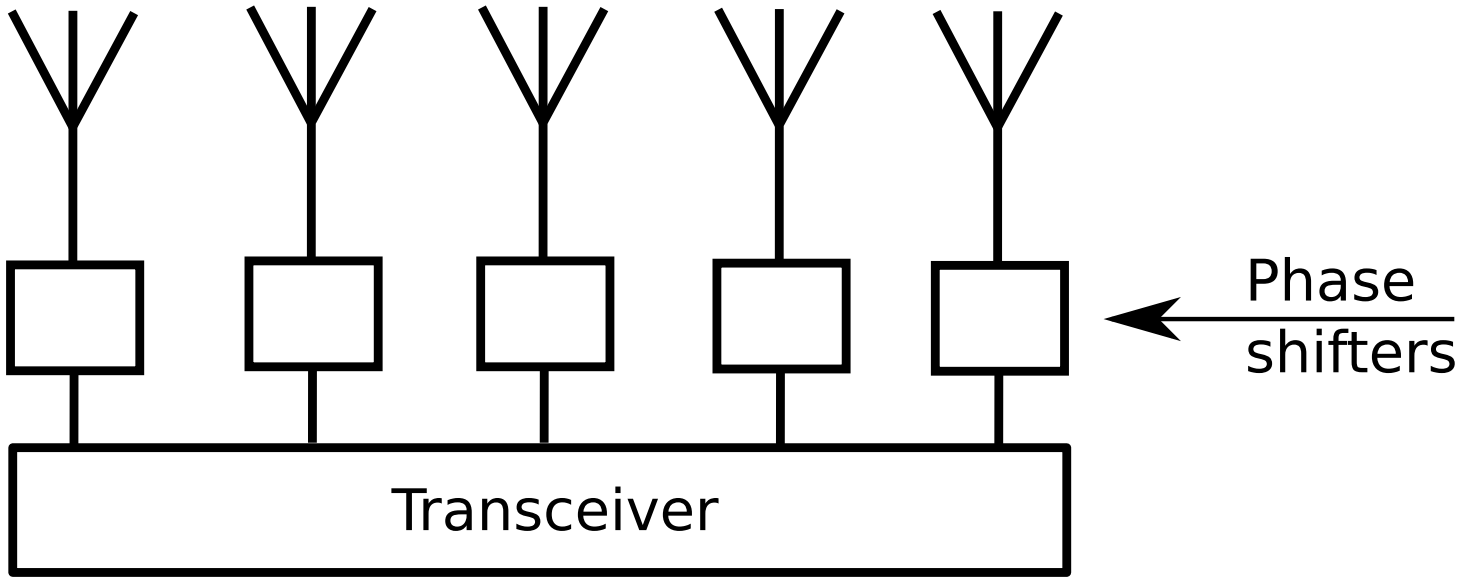
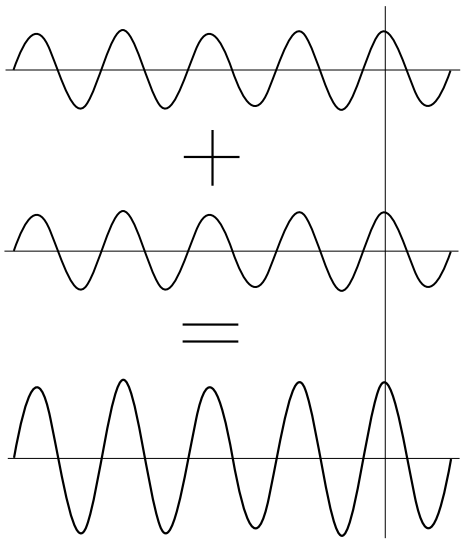
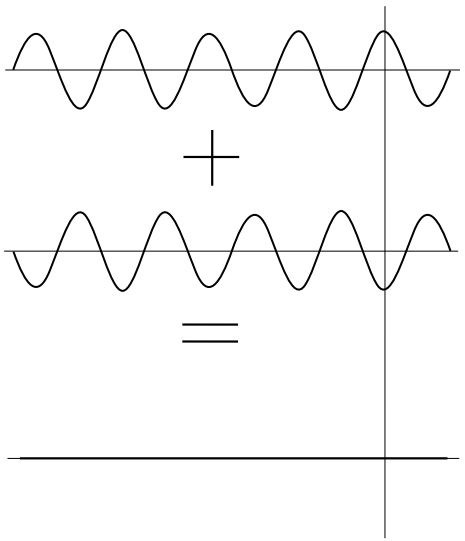
- Spatial signal filtering
- Any technique which can change the radiation pattern

Phase shift beamforming

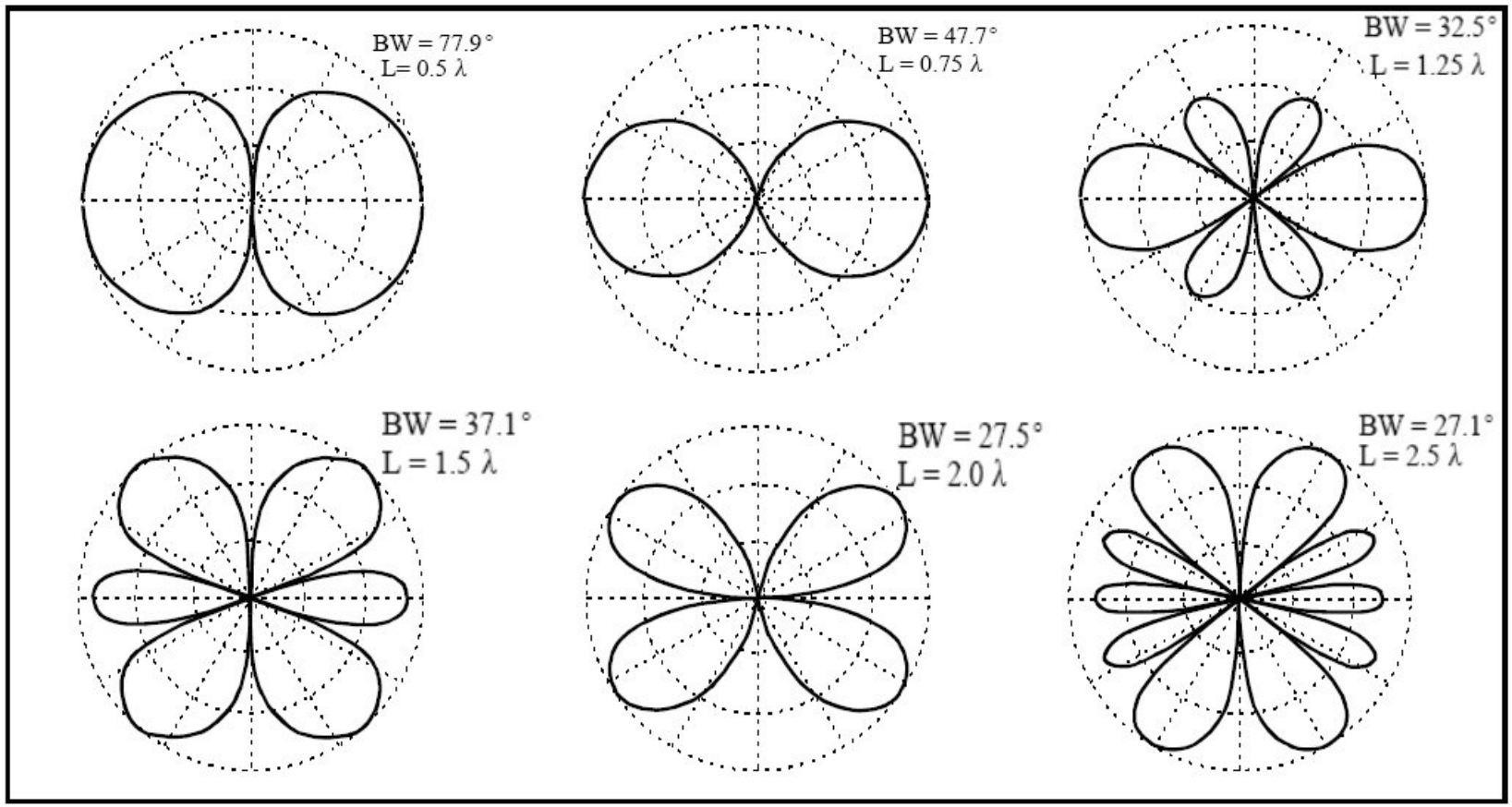

Phase
shifters
Transceiver

Phase shift beamforming
The principle



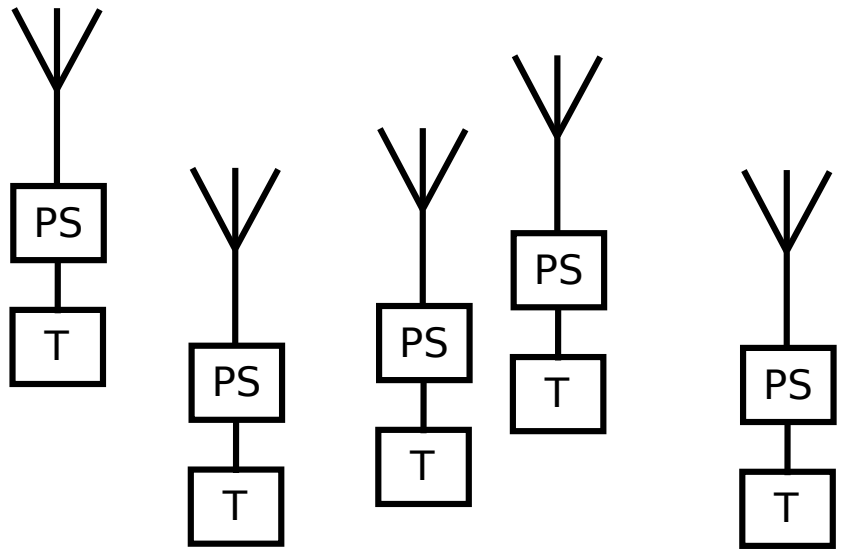


Phase shift beamforming
Examples



Distributed phase shift beamforming

The principle of the antenna array without central transmitter and with unknown antenna positions.

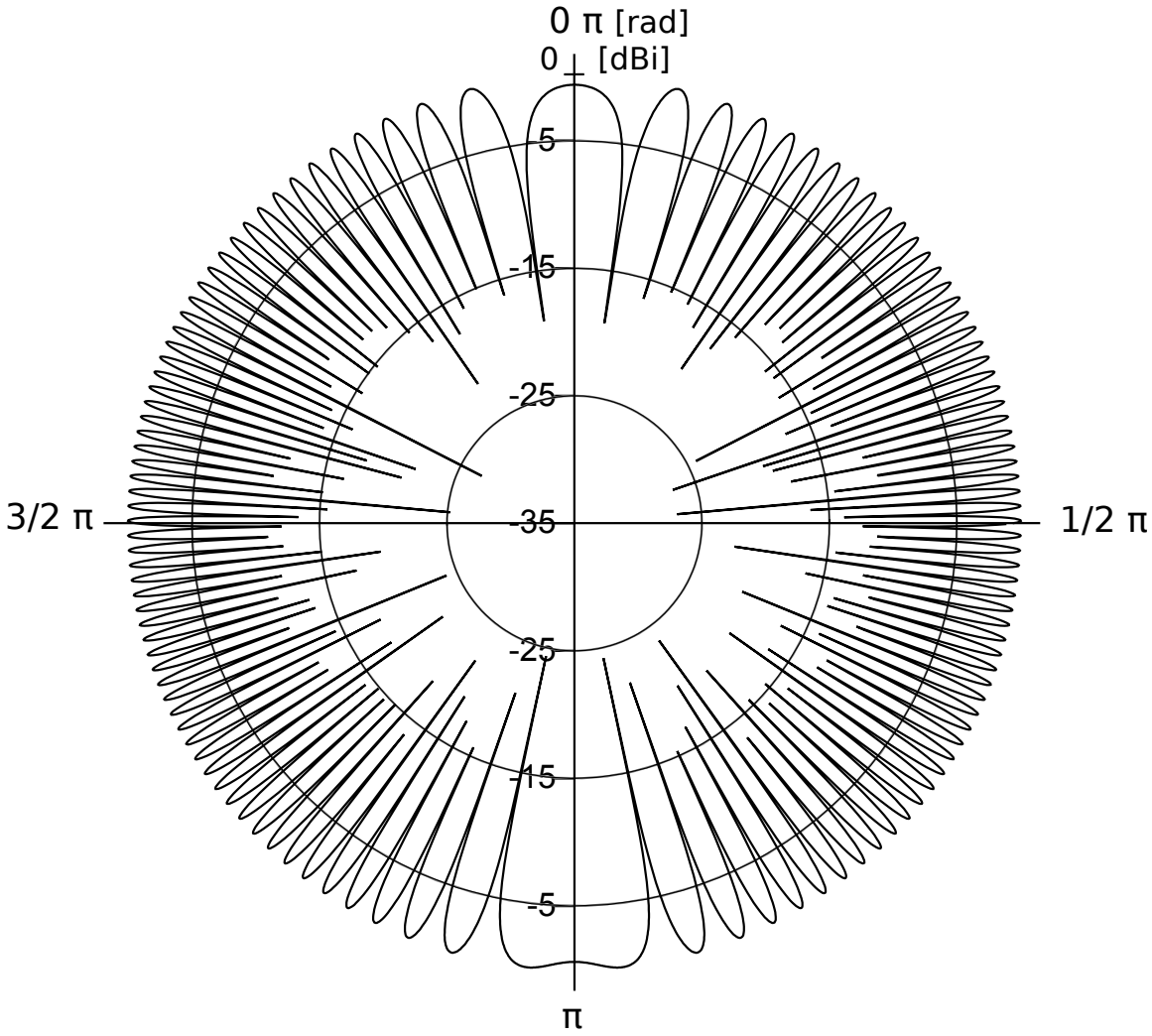


Phase shifters - PS

Transceivers - T

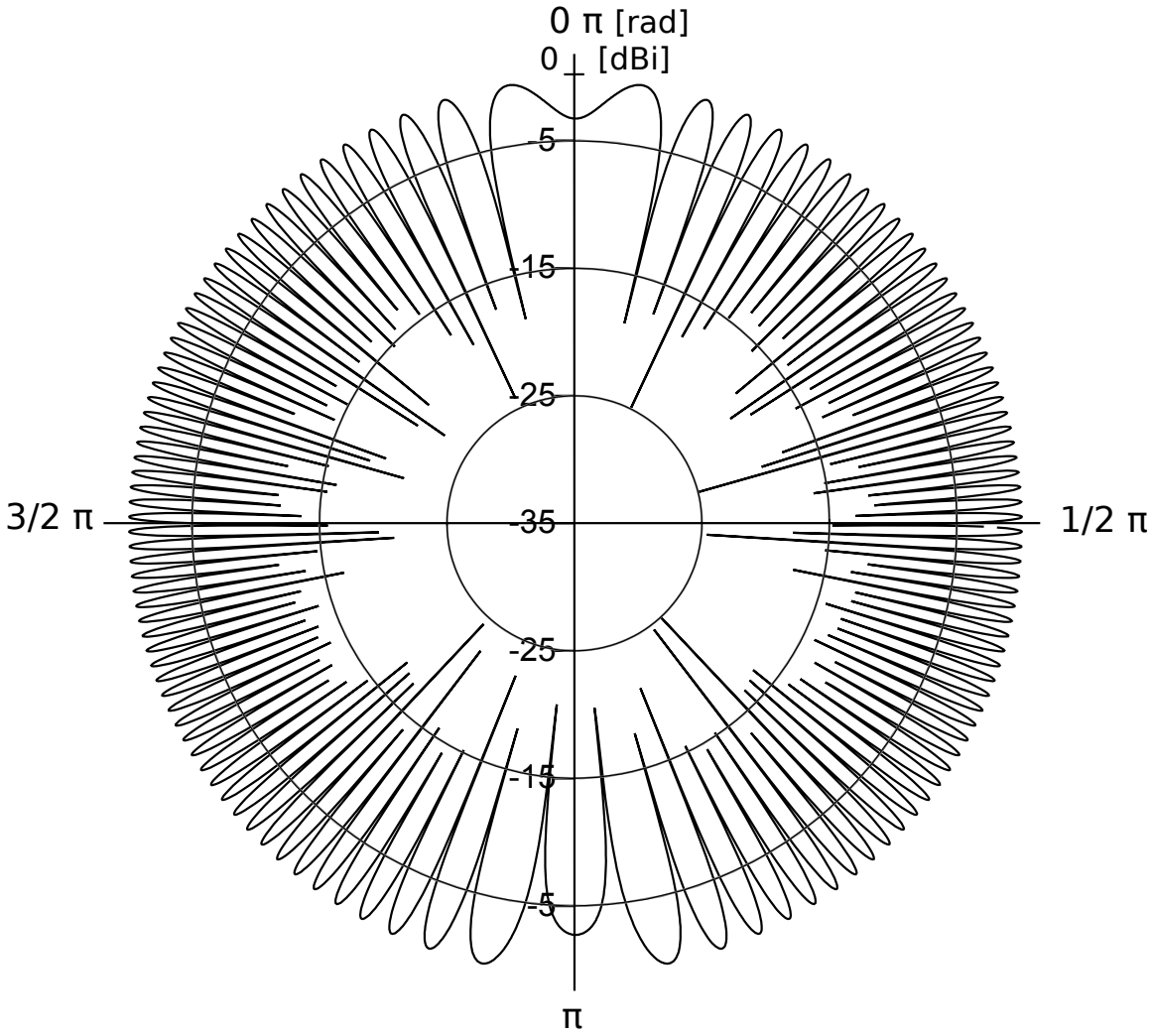
DPSBF - radiation pattern

Phase shift $\pi/3$, two transmitters, 30 wavelengths distance



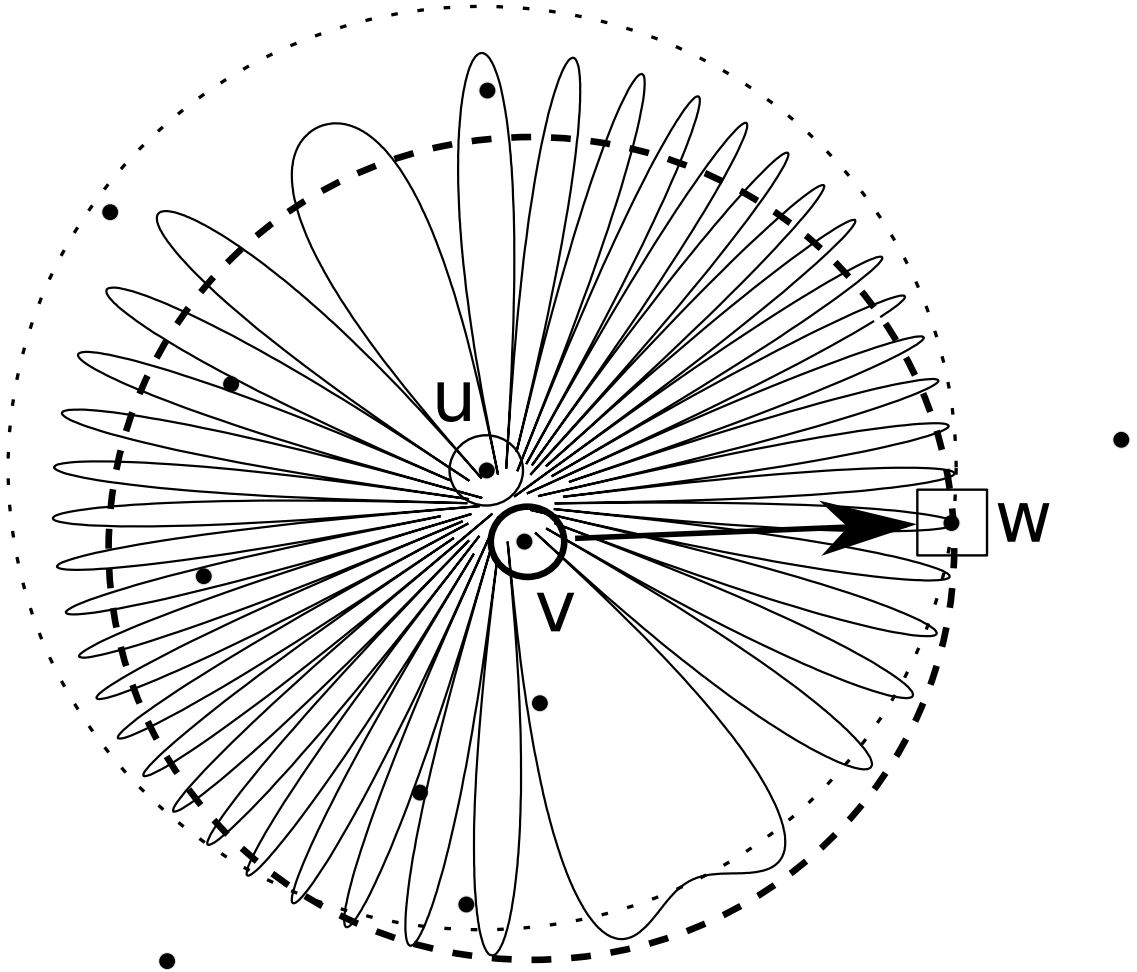
DPSBF - radiation pattern

Phase shift $\pi + \pi/3$, two transmitters, 30 wavelengths distance



Interference cancellation

Basic principle



$$trNumber = 2 * |E| * (avgNeigh - 1) * (360/MS + 2) \quad (1)$$

$$n = 360/MS \quad (2)$$

$$complexity = O(n) \quad (3)$$

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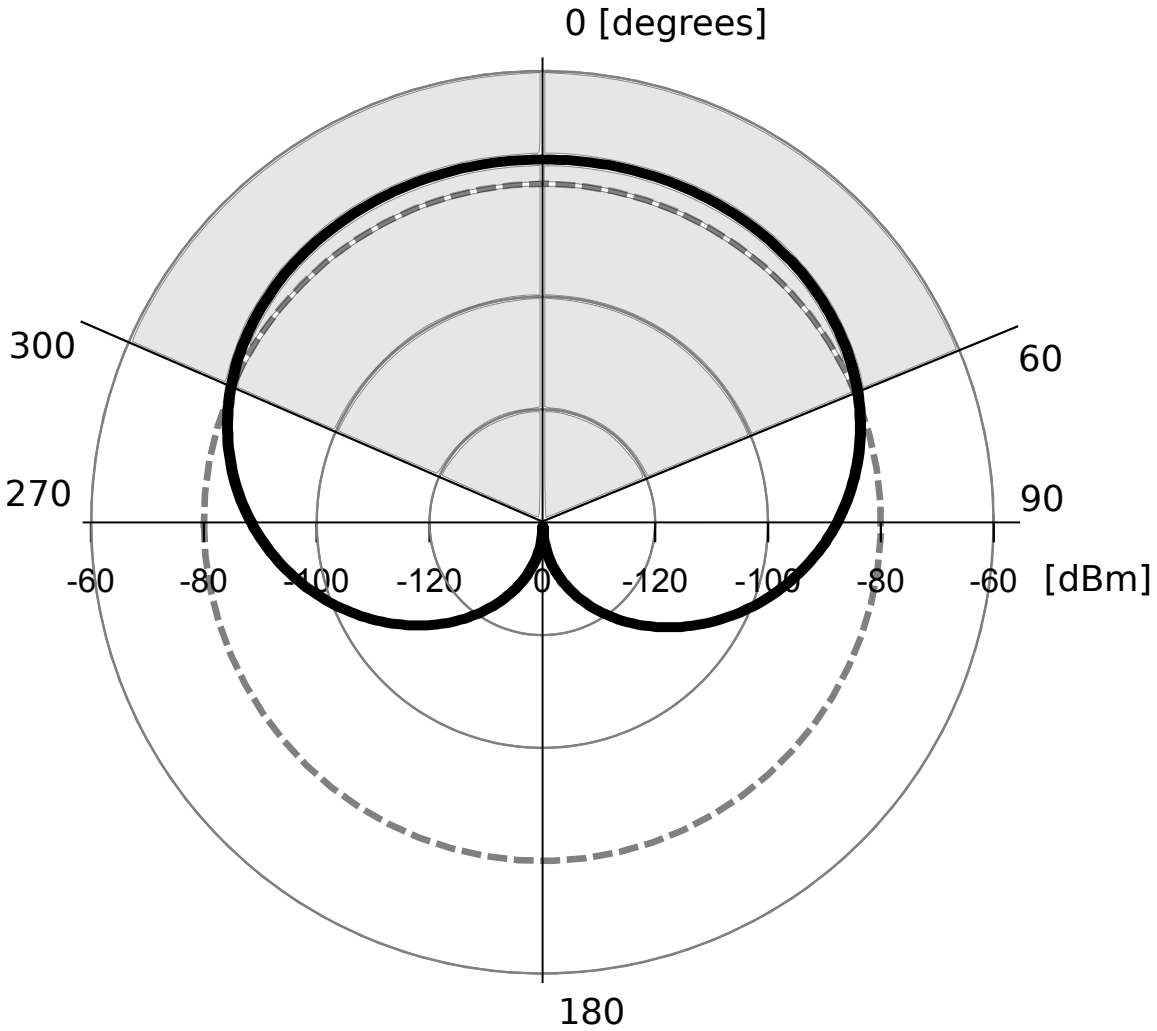
Phase shift searching

What is it about?



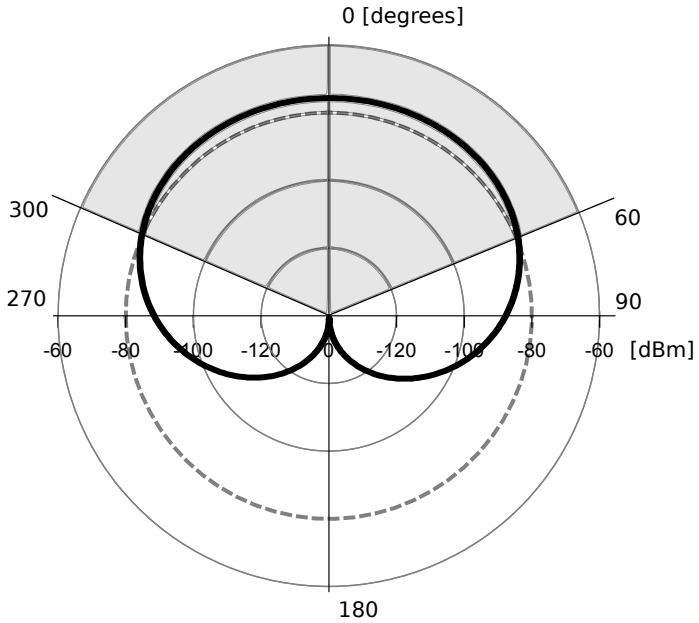
Phase shift searching

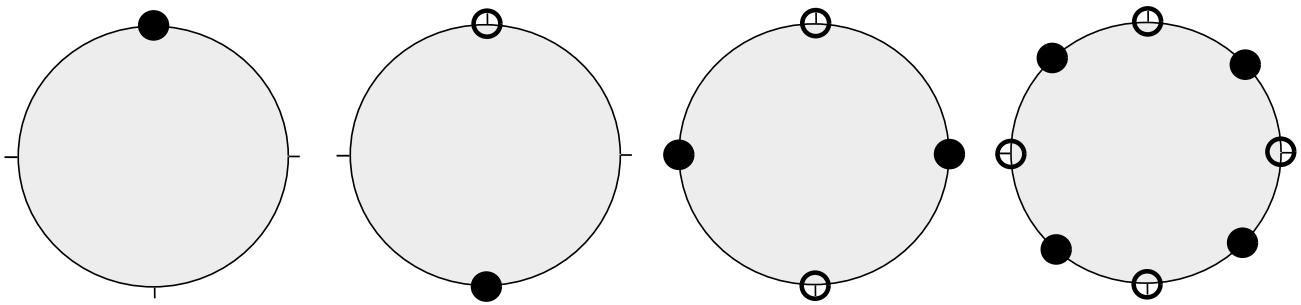
Stage 1

1: $SS \leftarrow 360$ ▷ Current searching step size
2: $used \leftarrow$ empty set ▷ Set of all checked values for SS
3: **while** $SS > MS$ **do** ▷ MS is the minimal step
4: $p \leftarrow 0$
5: **for** $p < (360/SS)$ **do**
6: **if** $s \notin used$ **then**
7: send(s, destination); $used \leftarrow s$
8: **end if**
9: $p \leftarrow p + 1$
10: **end for**
11: $SS \leftarrow SS/2$; ask the destination host for the results
12: **if** destination received signal **then**
13: $phase \leftarrow$ best received phase; **break**
14: **end if**
15: **end while**

Phase shift searching

Stage 1 - progress example





SS=360 SS=180 SS=90 SS=45

Phase shift searching

Stage 2

1: $phase \leftarrow$ best confirmed phase from the Stage 1
2: SS remains unchanged from the Stage 1
3: **while** $SS > MS$ **do**
4: send$(phase + SS, destination)$
5: send$(phase - SS, destination)$
6: ask the destination for the result
7: according the confirmation do:
8: $phase \leftarrow [phase + SS | phase - SS | SS]$
9: $SS \leftarrow SS/2$
10: **end while**

1: $phase \leftarrow 0$
2: execute the Stage 1
3: **if** the Stage 1 was successful **then**
4: execute the Stage 2
5: **return** *phase*
6: **else**
7: ▷ The Stage 1 did not find the usable phase shift
8: **return** ERROR
9: **end if**

Maximal number of transmissions

$$3 + \sum_{i=0}^{\log_2(n)} (2^i + 2) \tag{4}$$

Best case complexity

$$\Omega(1) \tag{5}$$

Worst case complexity

$$O(n + log_2(n)) \tag{6}$$

Number of transmissions

$$4 \log_2(n) \tag{7}$$

Complexity

$$\Theta(log_2(n)) \tag{8}$$

Best case complexity

$$\Omega(log_2(n)) \tag{9}$$

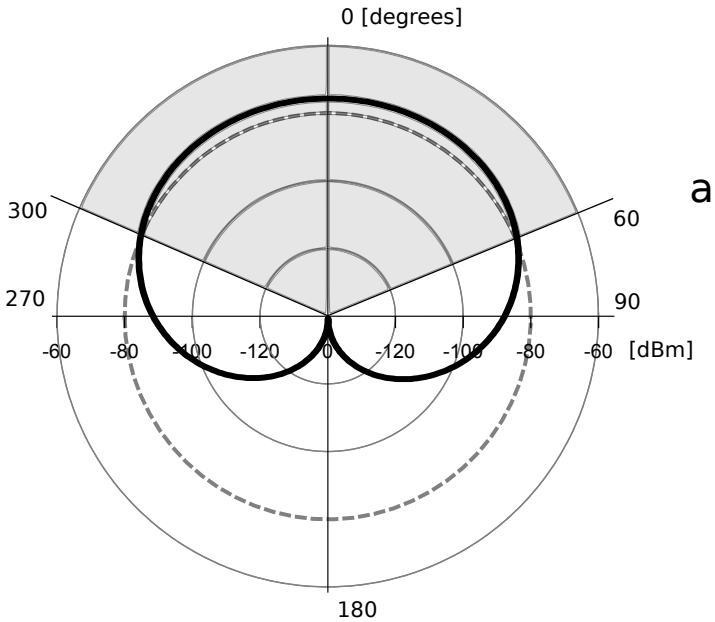
Worst case complexity

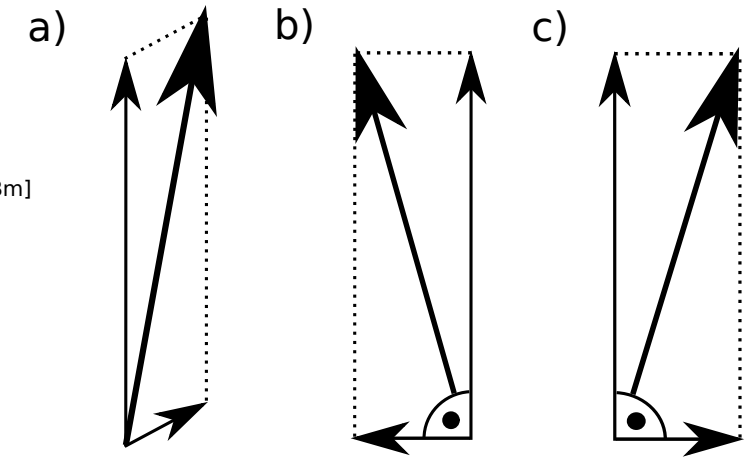
$$O(n + log_2(n)) \tag{10}$$

Theorem

Stage 1 of the proposed algorithm finishes the most in two steps in all possible cases.

Proof of theorem





Final complexity

$$\Theta(log_2(n)) \tag{11}$$

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Improvement

The complexity of the phase searching was improved from the linear complexity to the logarithmic.

Thank you for your attention!