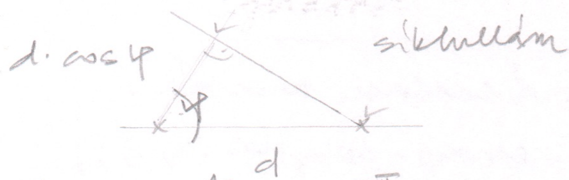
1) Beérkezési irány meghatározás

a) Steering vektor

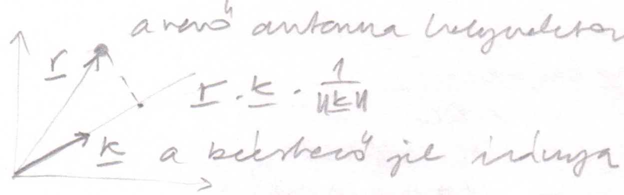
adó: $e^{j\omega t}$ vevő: $e^{j\omega(t-\tau)} = e^{j\omega(t-\frac{s}{c})} = e^{j\omega t}\cdot e^{-j\omega\frac{s}{c}}$

$\Delta\phi = -\omega\frac{s}{c} = -2\pi f\frac{s}{c} = -2\pi\frac{s}{\lambda}$



$$\Delta\phi = -2\pi\frac{\Delta s}{\lambda} = -\frac{2\pi}{\lambda}\cdot d\cdot\cos\varphi$$

általánosan:



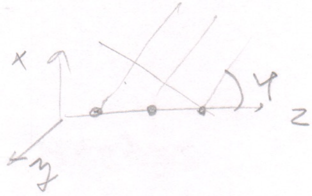
$$\Delta\phi = -2\pi\frac{\Delta s}{\lambda} = -\frac{2\pi}{\lambda}\cdot \underline{r}\cdot\underline{k}\cdot\frac{1}{\|\underline{k}\|} = -\underline{r}\cdot\underline{k}$$

ULA:

$\underline{r}_n = [0, 0, n\cdot d]$ $n = 0..N-1$

$\underline{k} = a\cdot[\sin\varphi, 0, \cos\varphi]$

$\|\underline{k}\| = \frac{2\pi}{\lambda} = a$



$$\Delta\phi = -\underline{k}\cdot\underline{r}_n = -\frac{2\pi}{\lambda}\cdot n\cdot d\cos\varphi$$

$$\boxed{a_n(\varphi) = e^{-j\frac{2\pi}{\lambda}(n-1)\cdot d\cdot\cos\varphi}}$$ [1...

b) Beamforming

w_i: $y(t) = \sum_{i=1}^{N} w_i^*\cdot x_i(t) = \underline{w}^H\cdot\underline{x}(t)$

$$P(\underline{w}) = \frac{1}{N}\sum_{t=0}^{L}|y(t)|^2 = \frac{1}{N}\sum_{t=0}^{L}\underline{w}^H\,\underline{x}(t)\cdot\underline{x}^H(t)\cdot\underline{w} =$$

$$= \underline{w}^H\left[\frac{1}{N}\sum\underline{x}(t)\cdot\underline{x}^H(t)\right]\cdot\underline{w} = \underline{w}^H\cdot\hat{\underline{R}}\cdot\underline{w}$$

kovariancia mátrix

maximális teljesítmény:

$\underline{w} = \underline{a}(\varphi)$

c) DOA

Bartlett: $$P(\varphi) = \frac{a^H(\varphi)\,\hat{R}\,a(\varphi)}{a^H(\varphi)\,a(\varphi)}$$

Capon: $$P(\varphi) = \frac{1}{a^H(\varphi)\,R^{-1}\,a(\varphi)}$$

MUSIC: $$P(\varphi) = \frac{1}{a^H(\varphi)\,E_n\cdot E_n^H\cdot a(\varphi)}$$

2) Alapsávi minták előállítása

-- (IQMod) -------- $r^r(t)$ (IQDem) — $s^r(t)$

$$s^r(t) = r^r(t)\cdot e^{-j(\omega^r t+\varphi_0)} = \sum_k A_k\, s(t-\tau_k)\, e^{j\omega^t(t-\tau_k)} \cdot e^{-j(\omega^r t+\varphi_0)}$$

$$= \sum_k A_k\, s(t-\tau_k)\, e^{j[\underline{(\omega^t-\omega^r)}t - \underline{\omega^t\tau_k} - \varphi_0]}$$

alapsávi kompenzálatlan minták:

```
plot(data.array.samples(:,1));
```

real: Barker kód

Preprocess:

kompenzáció:

- AGC
- DC offset
- Normalizáció

→ rc

visszaforgatás:

- a korreláció szögével

```
plot(data.corr.values,'ro:')
```

→ rr/rf

súlyozás antennakalibráció alapján

→ r