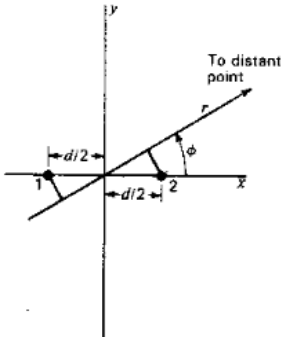
一、簡介(Introduction)

利用麥克風陣列來做Beamforming偵測聲源所在方位，再利用 Chebyshev 來壓抑雜訊，最後聲源方位找出。

二、理論(Theoretical)

無限遠處的 source 所發出訊號被兩個麥克風接收，相對於原點的 phasor 和：



$$\Psi = d_r cos\ \emptyset$$

$$d_r = \frac{2\pi d}{\lambda}$$

$$E(\emptyset) = E_0 e^{-j\Psi/2} + E_0 e^{+j\Psi/2}$$

$$= 2E_0 \frac{e^{-j\Psi/2} + e^{+j\Psi/2}}{2}$$

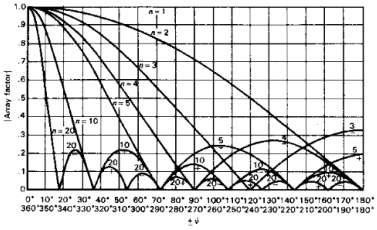
$$= 2E_0 \cos\frac{\Psi}{2} = 2E_0 \cos\left(\frac{d_r}{2}\cos\emptyset\right)$$

N 個麥克風的情形：

$$E(\emptyset) = e^{-j(N-1)\Psi/2} + \cdots + e^{-j\Psi/2} + e^{+j\Psi/2} + e^{+j(N-1)\Psi/2}$$

$$= e^{-j\frac{N-1}{2}\Psi} \frac{1-e^{-jN\Psi}}{1-e^{-j\Psi}}$$

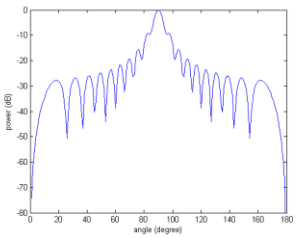
$$= \frac{sin(N\Psi/2)}{sin(\Psi/2)}$$

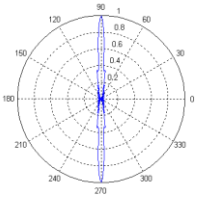


三、實驗(Experimental)

利用 Matlab 模擬 Beamforming 和 Chebyshev

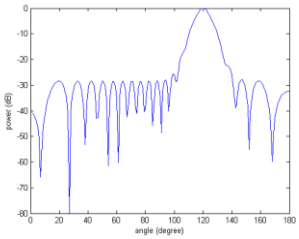
N = 20, d = 0.5, r = 100, λ = 2

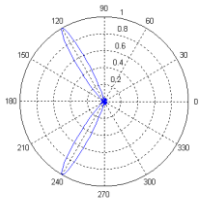




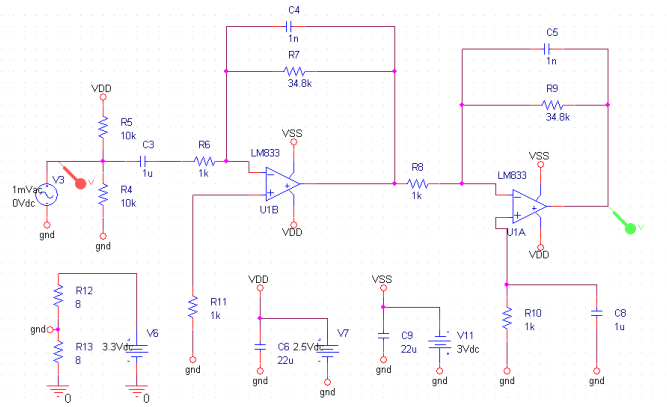
改變接收角度 θ：

N = 20, d = 0.5, r = 100, λ = 2, R = 30, θ = 30

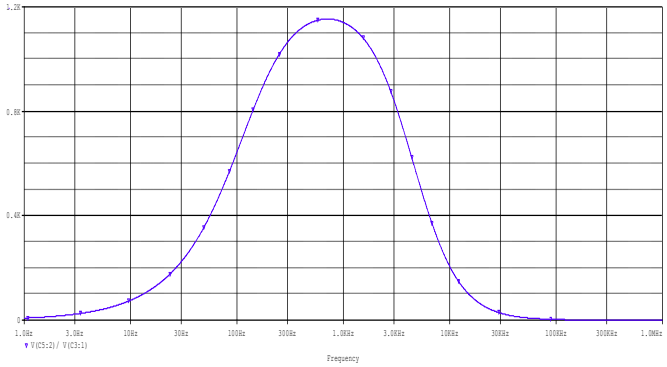




模擬前端電路



Frequency response



四、參考文獻(Reference)

Beamforming 參考資料:

https://www.engr.wisc.edu/ece/faculty/vanveen_barry/ASSP_Mag_88.pdf

http://www.nari.ee.ethz.ch/~studerc/papers/10ISCASacam.pdf

所用 IC 資料來源:

1. OP (LM833):

   http://www.national.com/ds/LM/LM833.pdf

2. ADC (AD7828):

   http://www.analog.com/static/imported-files/data_sheets/AD7824_7828.pdf