I C A

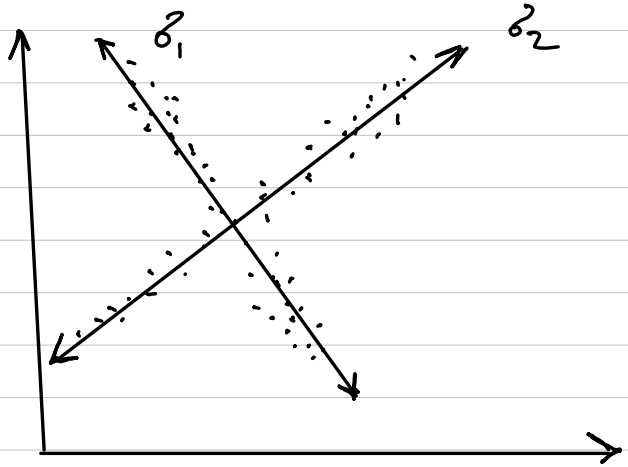
Independant Component Analysis

→ Technique used to seperate mixed signals

→ Used in signal processing → ① Audio
② Image

→ Used for feature extraction

→ Unsupervised learning technique

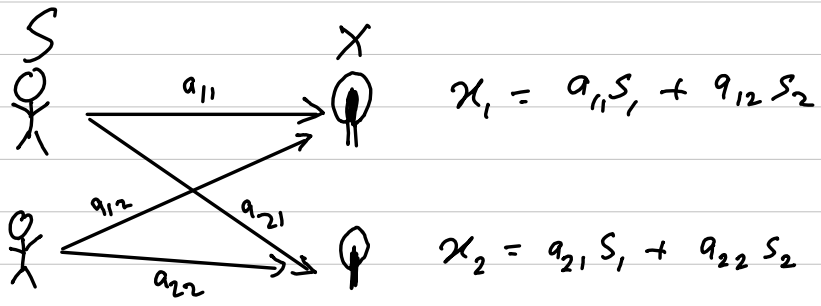


→ Blind source seperation technique

Cocktail Party Problem

There are n people in room & n microphones
Voice of the people is recorded in the microphones.

Goal is to seperate out the voices of people



We have X and need to calculate S

Here we are assuming that the n people are all stastically independant

This is the main assumption that allows us to solve PCA

Mathematical expressions →

$$X_1(t) = a_{11} s_1(t) + a_{12} s_2(t)$$

$$X_2(t) = a_{21} s_1(t) + a_{22} s_2(t)$$

a_{ij} → Mixing coeficients

Unknowns → a_{ij} → 4 } 6 unknowns
$X_i(t)$ → 2

2 constraints (equations)

We cannot solve directly.

In Matrix form

$$X = AS \quad -(1)$$
$$\therefore S = A^{-1}X \quad -(2)$$

ICA calculates S from X

So we need to find a transformation matrix A such that A maximizes the independance of hidden components

Given N distinct linear combinations of N elements, determine the original N elements

Assumptions in ICA →

1) Original signals are stastically independant
2) Each source exibits non-gaussian distributions

Applications →

① seperation of mixed signals } ML
② Used for feature extraction }
③ Radar detection →

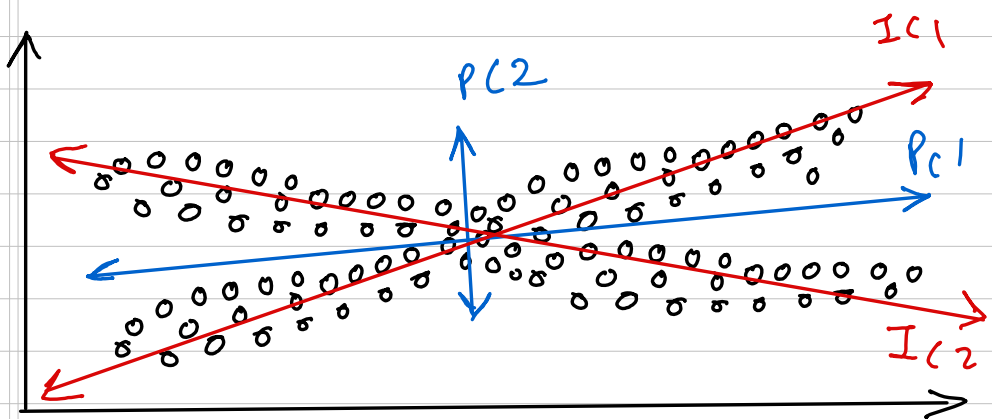
example there are many planes & many radars
How can we find out which plane is detected

④ EEG activity

Disadvantages →

1. ICA is used to separate linear mixtures
2. If mixture is not linear, then ICA fails
3. ICA is computationally expensive
4. Convergence issues

ICA	PCA
Identifies independant sources	Identifies direction of maximum variance
Non Gaussian data	Gaussian data
Extract independant sources	Reduce dimentionality of data to avoid overfitting
May or may not be orthogonal, but are statically independant	Orthogonal components Not necessarily independant
Seperate information	Compress information



The direction of maximum variance is the one which gives most quality of data

Independant components are the directions of spread of the data