An auditory system modeling in sound localization
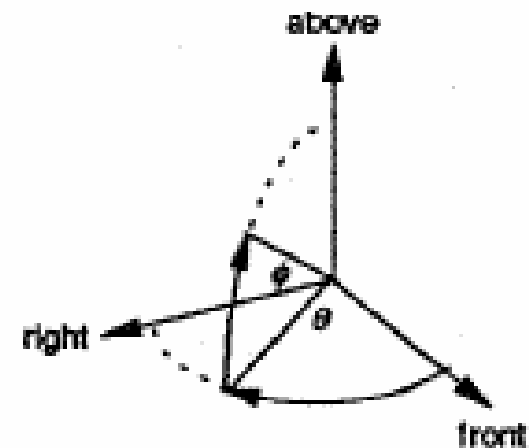
EE381K MDDSP
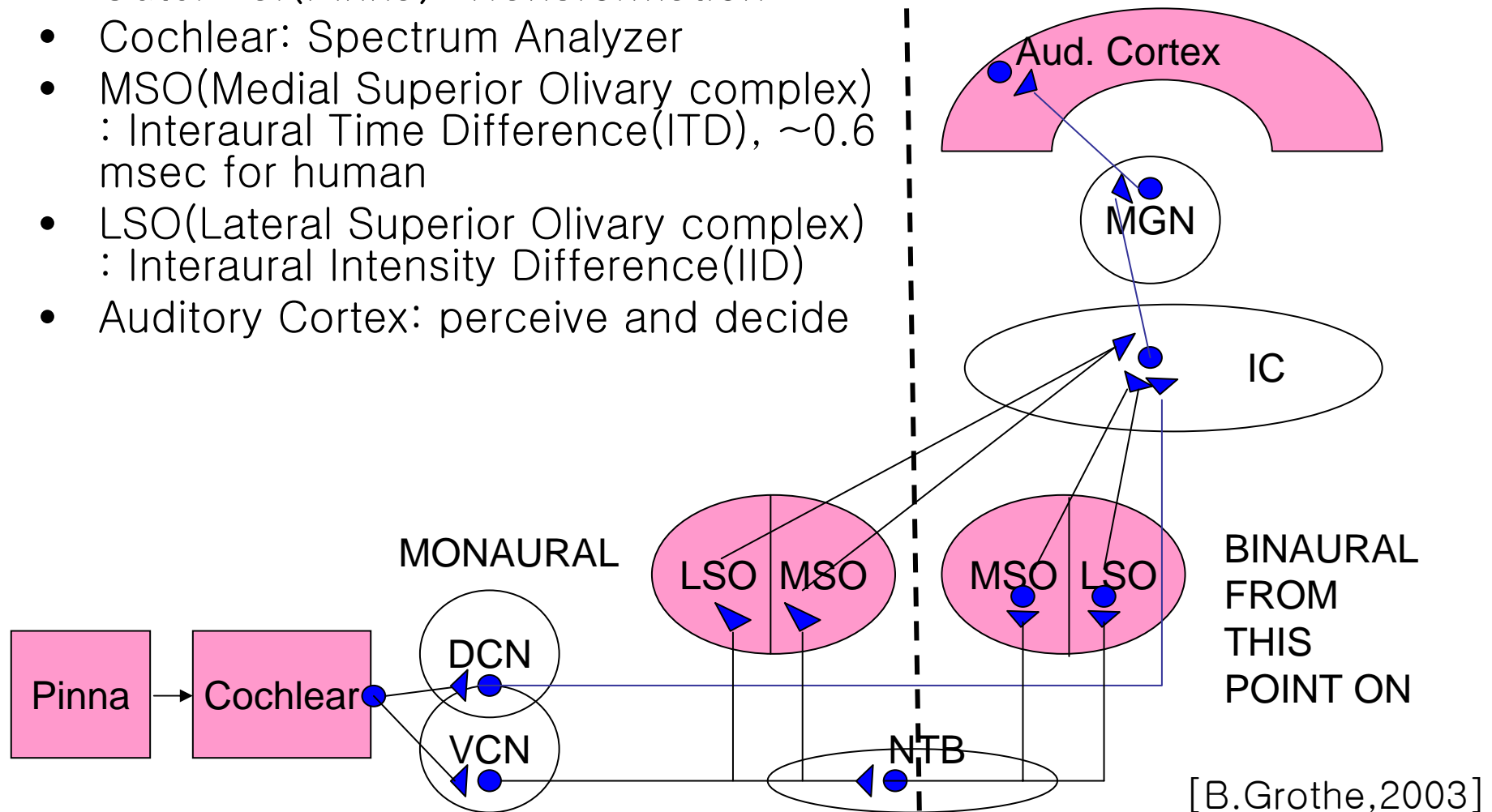
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Sound Localization

- Motivation:
  - Technology: Virtual 3D sound, game, sonar, microphone array, etc
  - Science: temporal/spatial resolution of the auditory system (reconstructed image by the brain)-> relation to higher cognitive functions: speech and music perception
- Localization Cues:
  - Monaural vs Binaural
- Parameters:
  - time and spectral difference
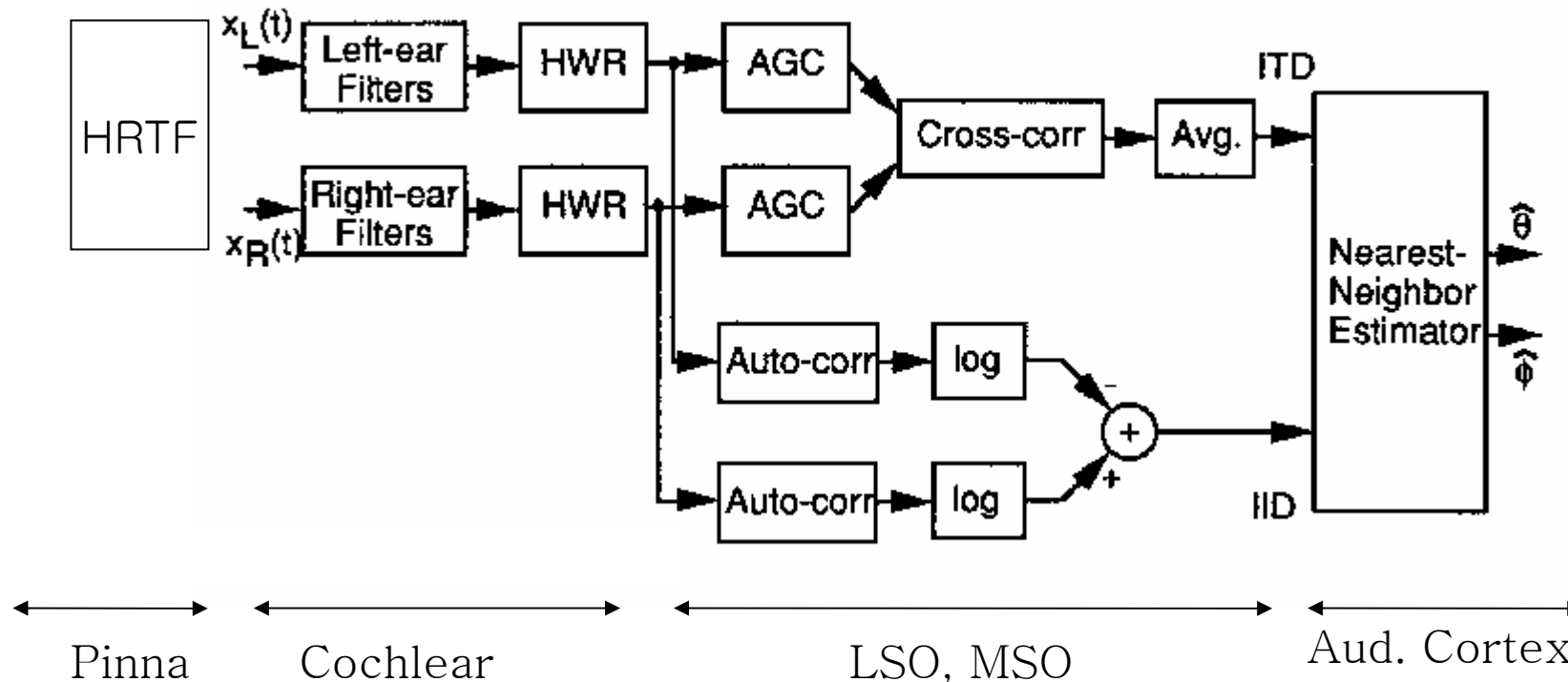 - Azimuth and Elevation

Auditory Signal Pathway

- Outer Ear(Pinna): Transformation
- Cochlear: Spectrum Analyzer
- MSO(Medial Superior Olivary complex)
  : Interaural Time Difference(ITD), ~0.6 msec for human
- LSO(Lateral Superior Olivary complex)
  : Interaural Intensity Difference(IID)
- Auditory Cortex: perceive and decide

Aud. Cortex

MGN

IC

MONAURAL

BINAURAL
FROM
THIS
POINT ON

LSO MSO   MSO LSO

Pinna → Cochlear

DCN

VCN

NTB

[B.Grothe,2003]

Conventional Modeling

-Time diff. by Cross correlator

-Spectral diff. by subtracter

-Weakness: front/back error, tone source, fixed structure, no-feedback, too fine spectral structure

[Lim&Duda,1994, Chau&Duda,1995, Martin,1995]

Suggested Modeling

- Feedback, Neural Network, and Evolution
  [Stanley & Miikkulainen, 2002]