Speaker Verification over Cellular Networks

Ran Gazit

Persay

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Standard Speech Corpora

• **TIMIT**	**clean**
• **YOHO**	**clean**
• **KING**	**clean**
• **SIVA**	**PSTN**
• **PolyVar**	**PSTN**
• **POLYCOST**	**ISDN**
• **Switchboard I-II**	**PSTN**
• **OGI Speaker Recognition**	**PSTN**

Campbell and Reynolds, ICASSP 99
Melin, COST 250, 2000

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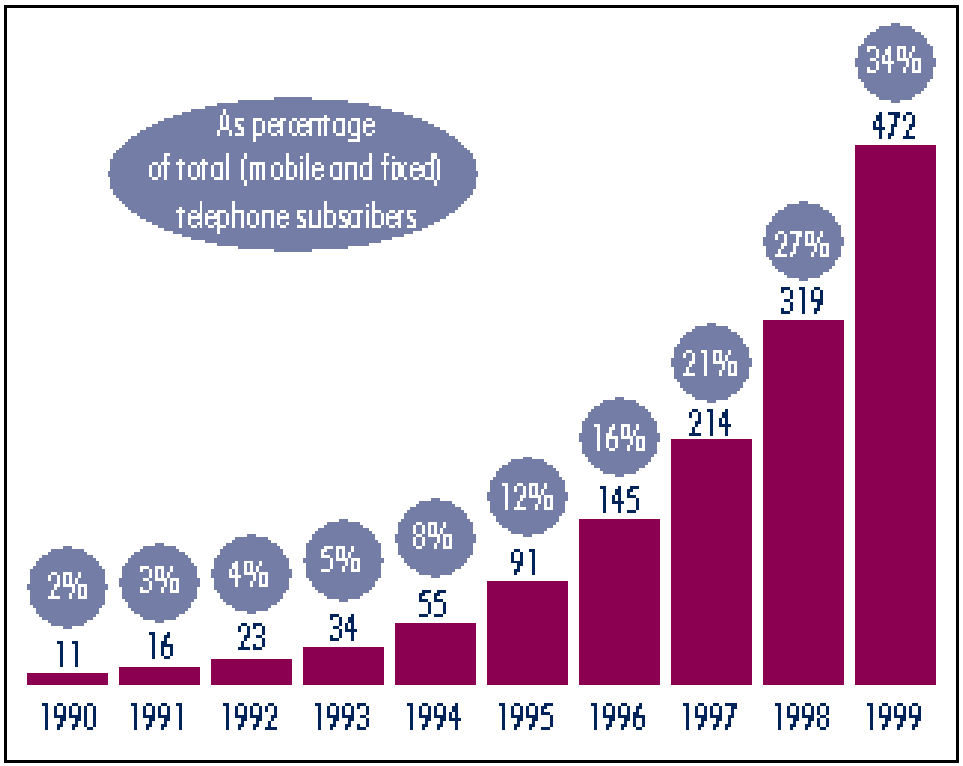
Cellular Penetration Rate

"It seems highly likely that the number of mobile cellular subscribers will surpass conventional fixed lines during the first decade…"

ITU World Telecommunication Development Report, 1999

WORLDWIDE MOBILE CELLULAR SUBSCRIBERS (MILLIONS)



Source: ITU, 2000.

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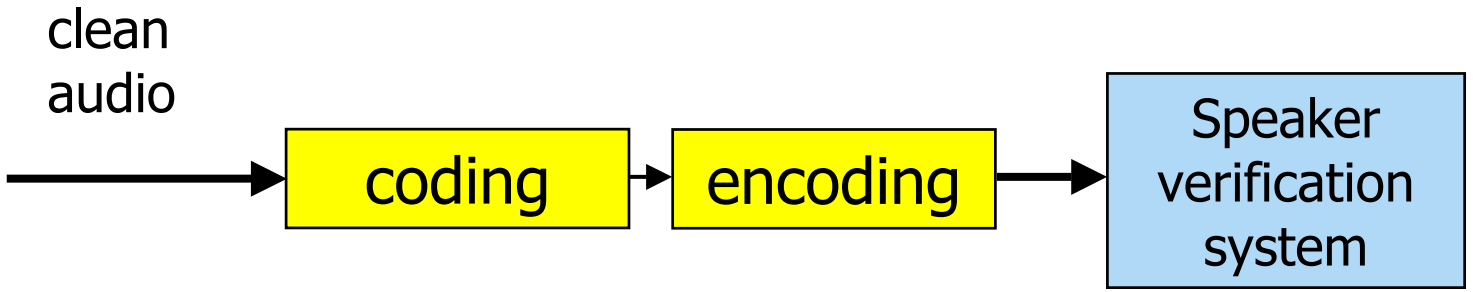
Previous Work

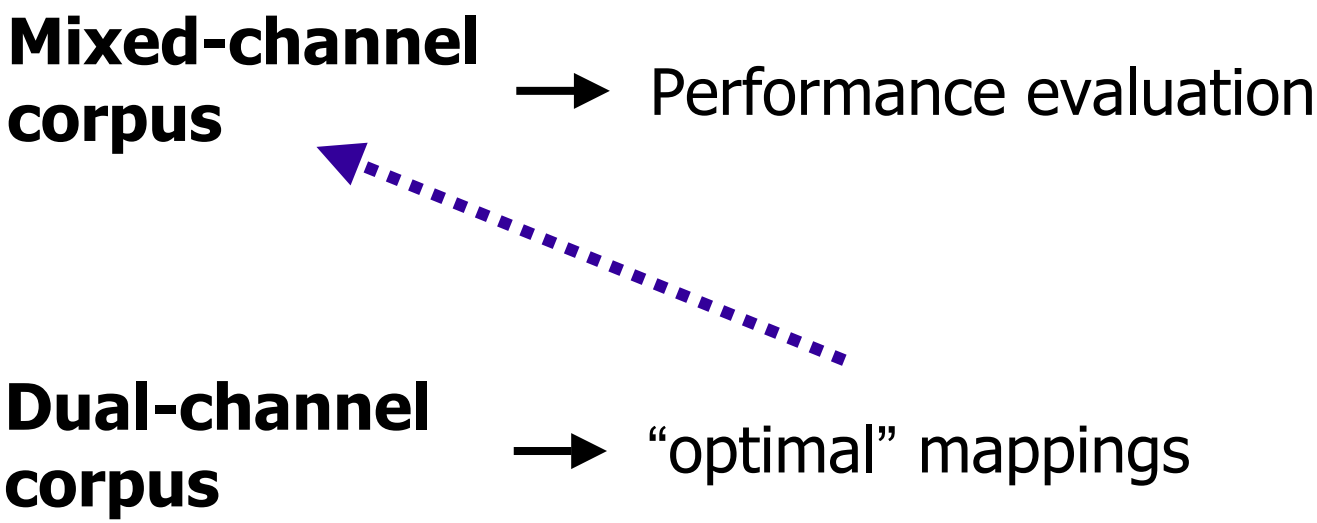


Kuitert and Boves, Eurospeech 97 (SESP - GSM)

Quatieri et. al., Eurospeech 99 (Swbrd - GSM, G.729, G.723.1)

Besacier et. al., ICASSP 2000 (TIMIT - GSM)

Method



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Mixed-Channel Corpus

Target speakers	43F / 42M 10 1 min. Land-line 10 1 min. Cellular (various)
Background speakers	60F / 60M 1 min Land-line 1 min Cellular (various)

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Experiment Setting

Working point	3 min. train 30 sec. test
System	25 ms frames, 12.5 ms shift Energy-based VOX 12 LPC-Ceps, CMS 12 delta-Ceps 30-mixture GMM Gender,channel-dependent BM

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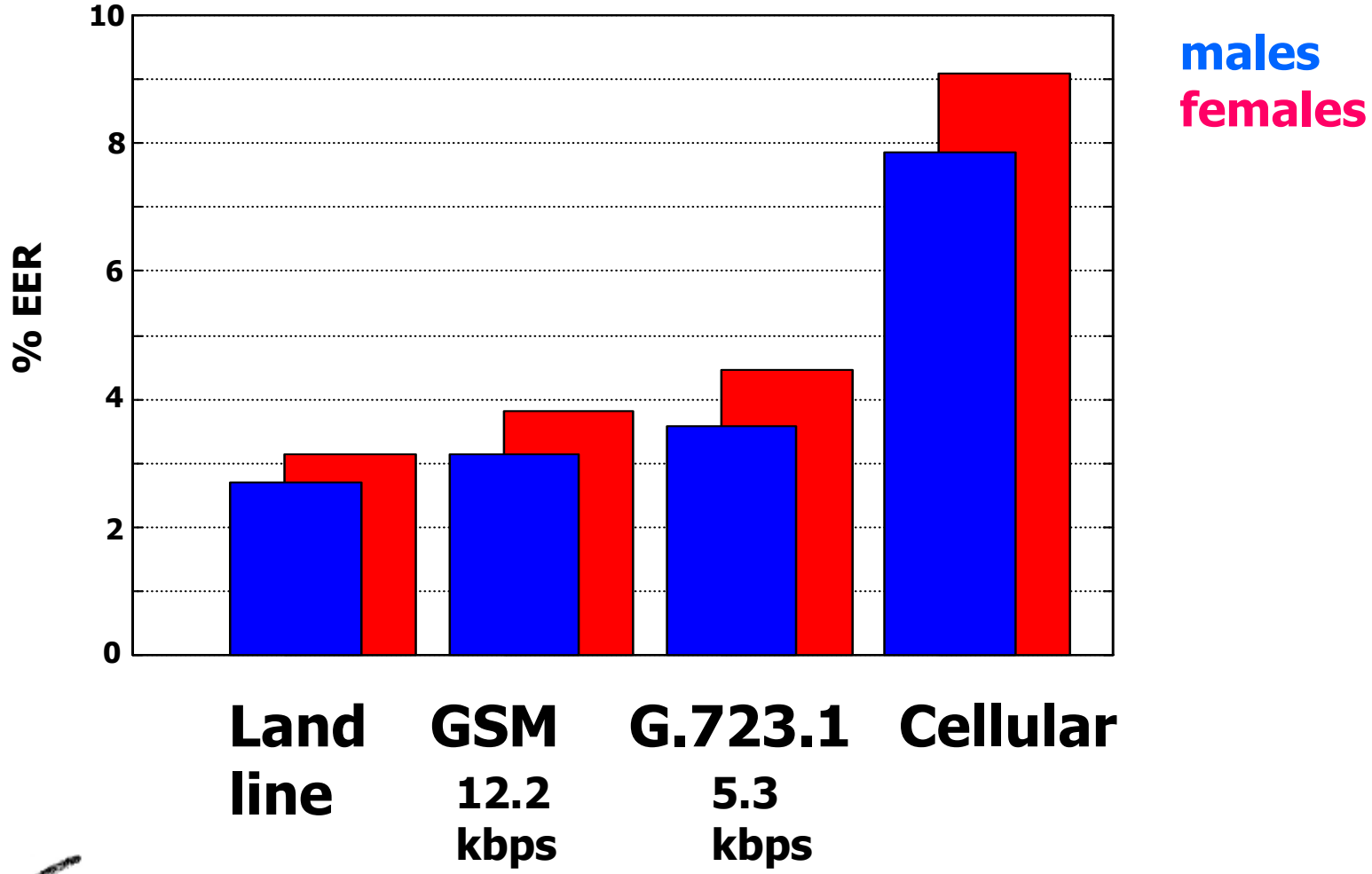
Matched-Conditions EER



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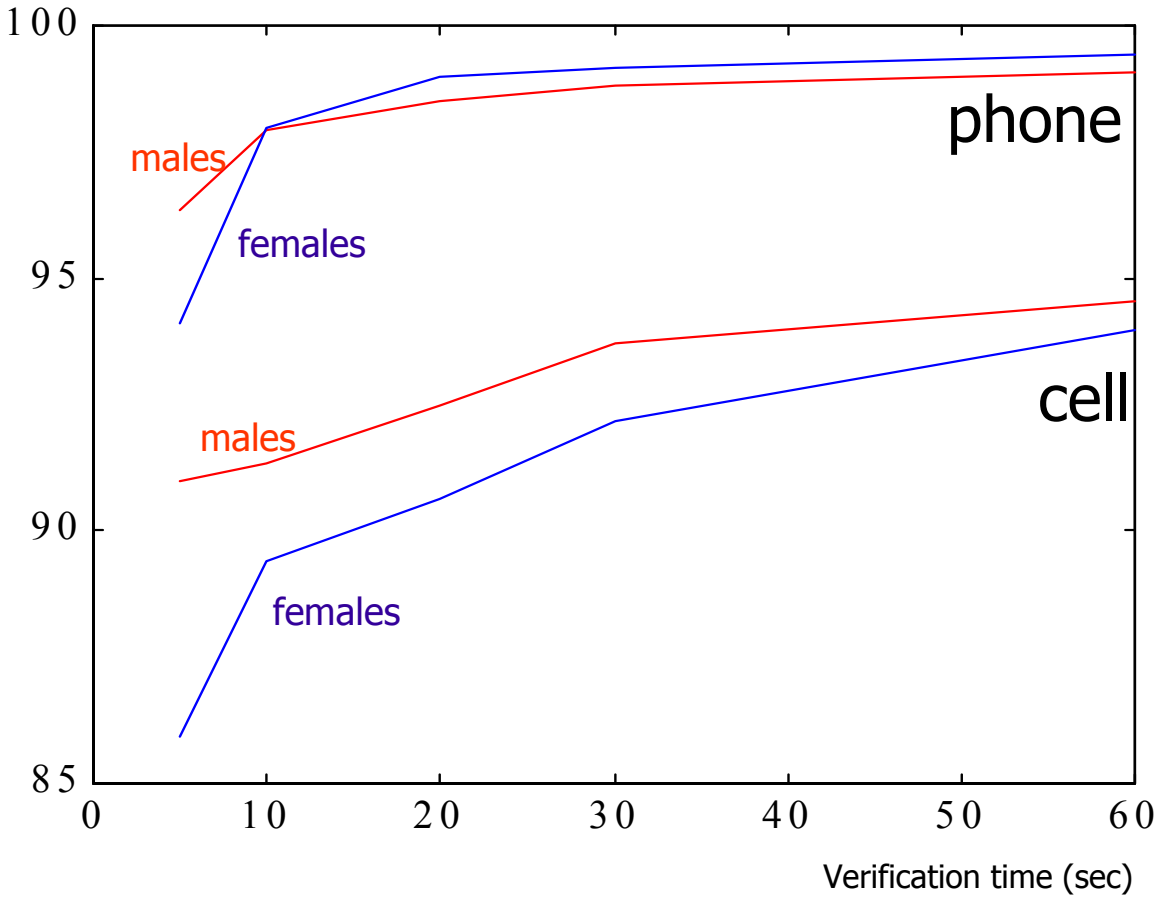
Confidence Level



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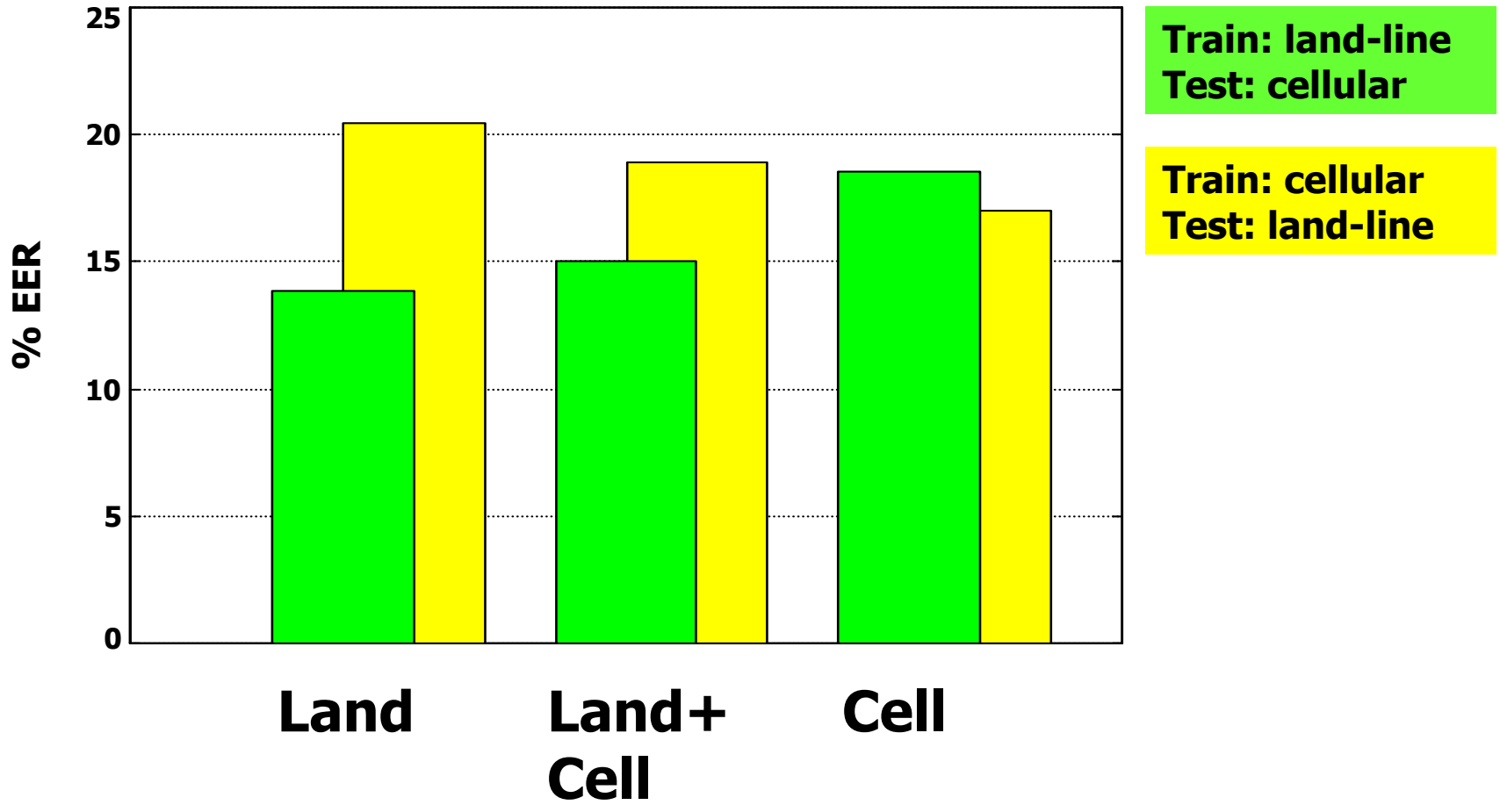
Mismatched-Conditions EER



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Dual-Channel Corpus

Target speakers

10F / 10M

1 min. Land-line & Cellular simultaneously

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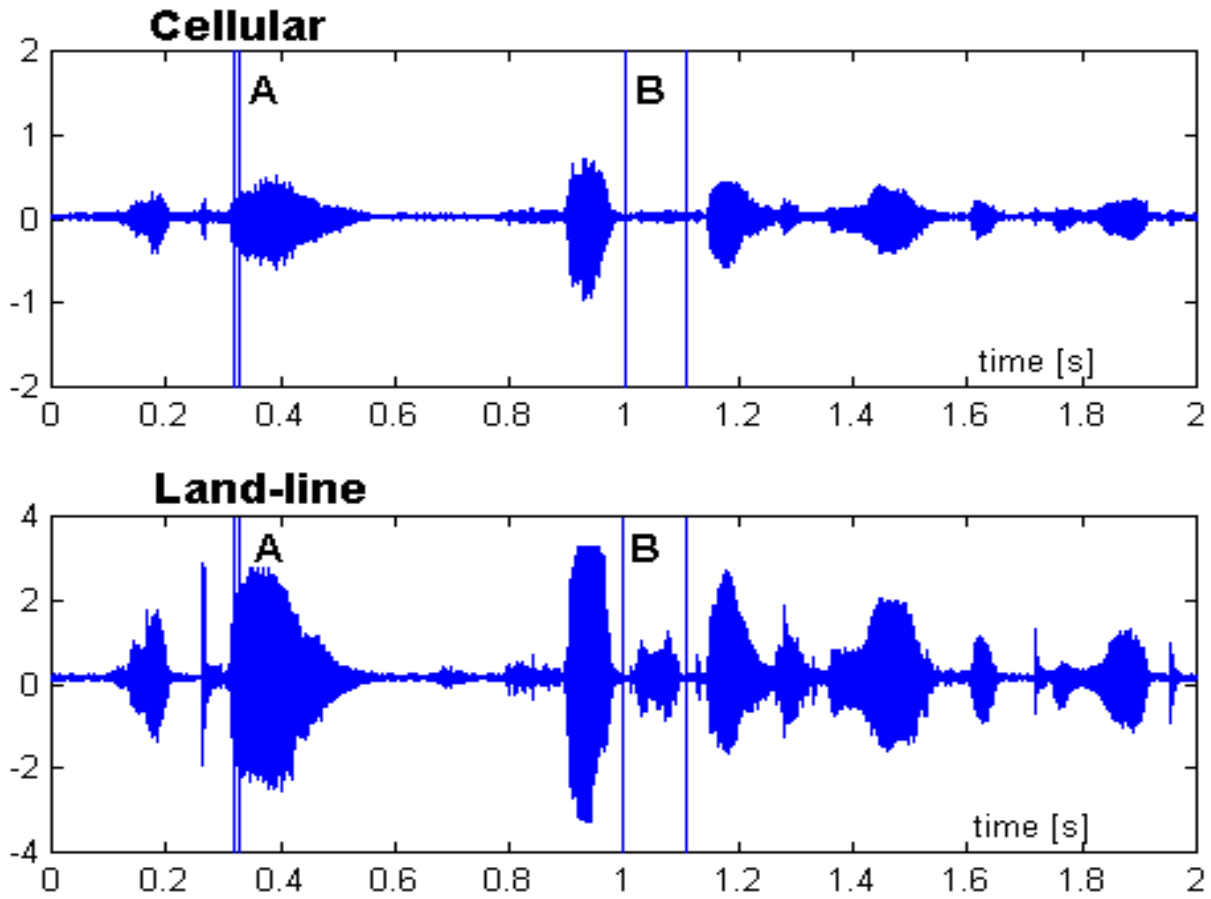
Dual-media Speech Signal



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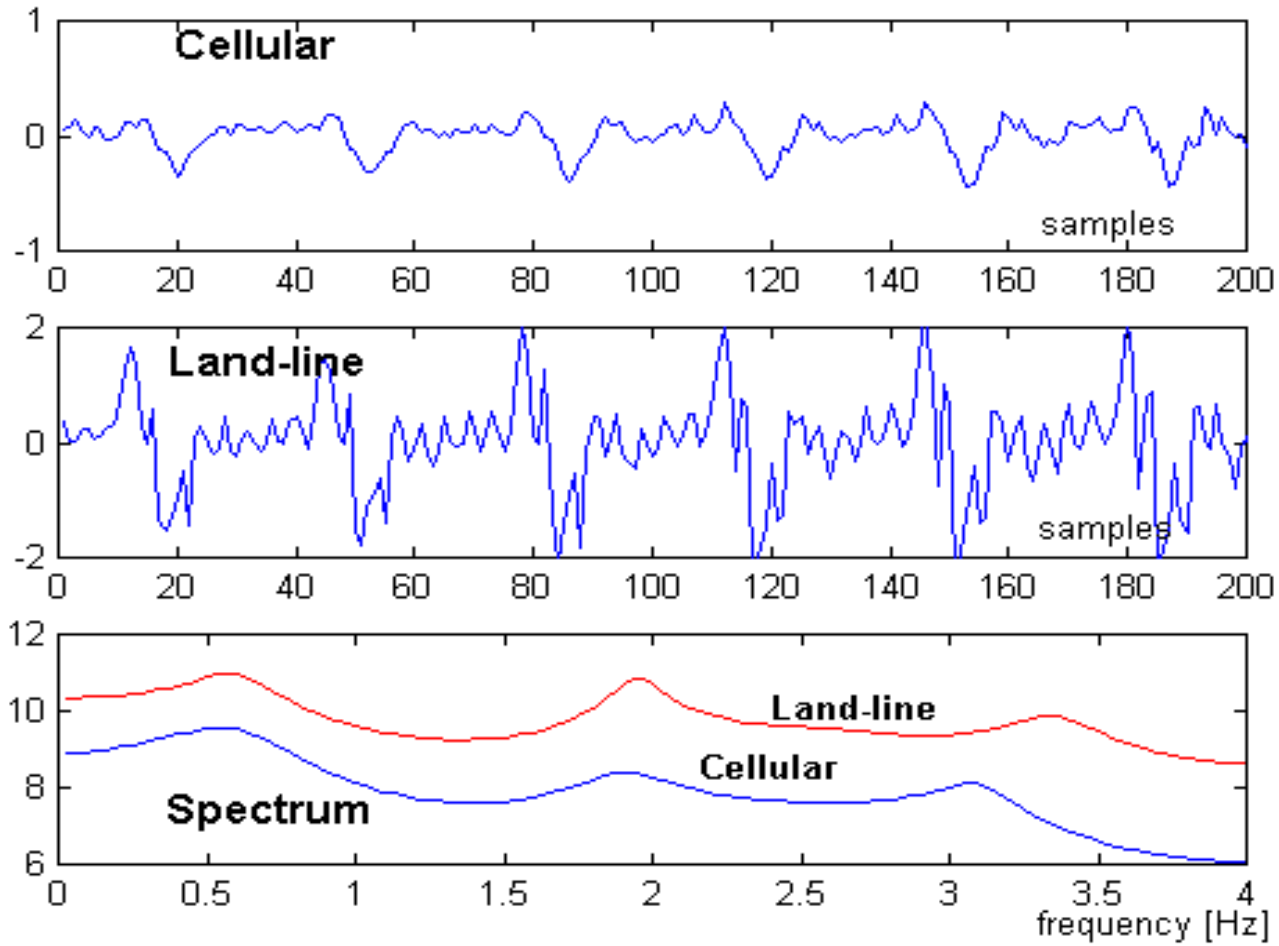
Dual-Media Speech Signal



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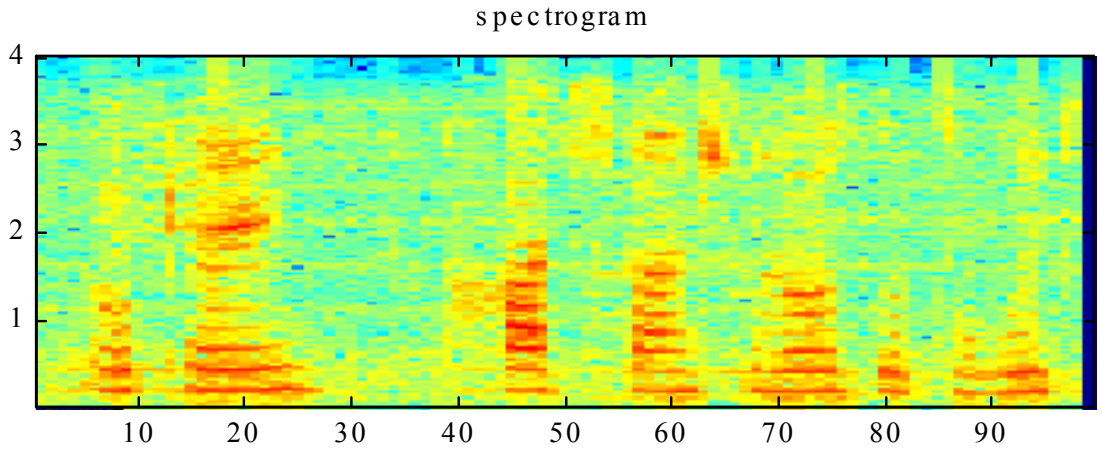
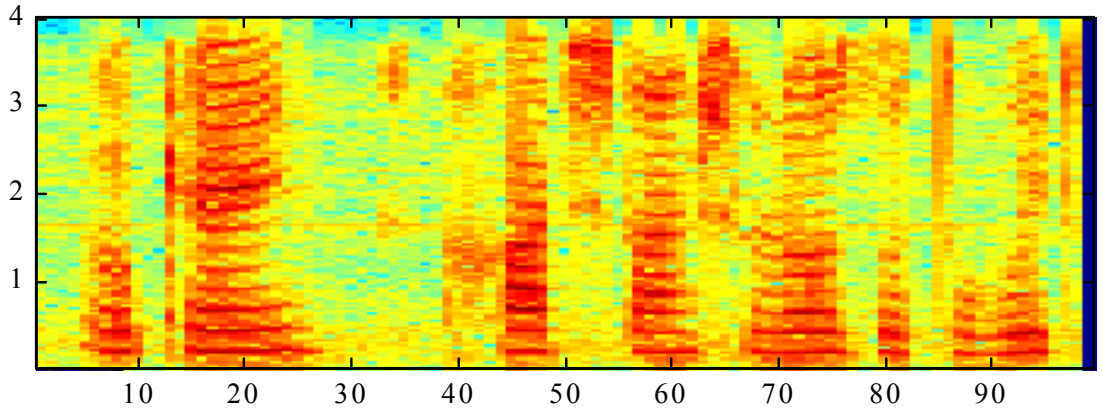
Dual-media Spectrogram

cell



phone



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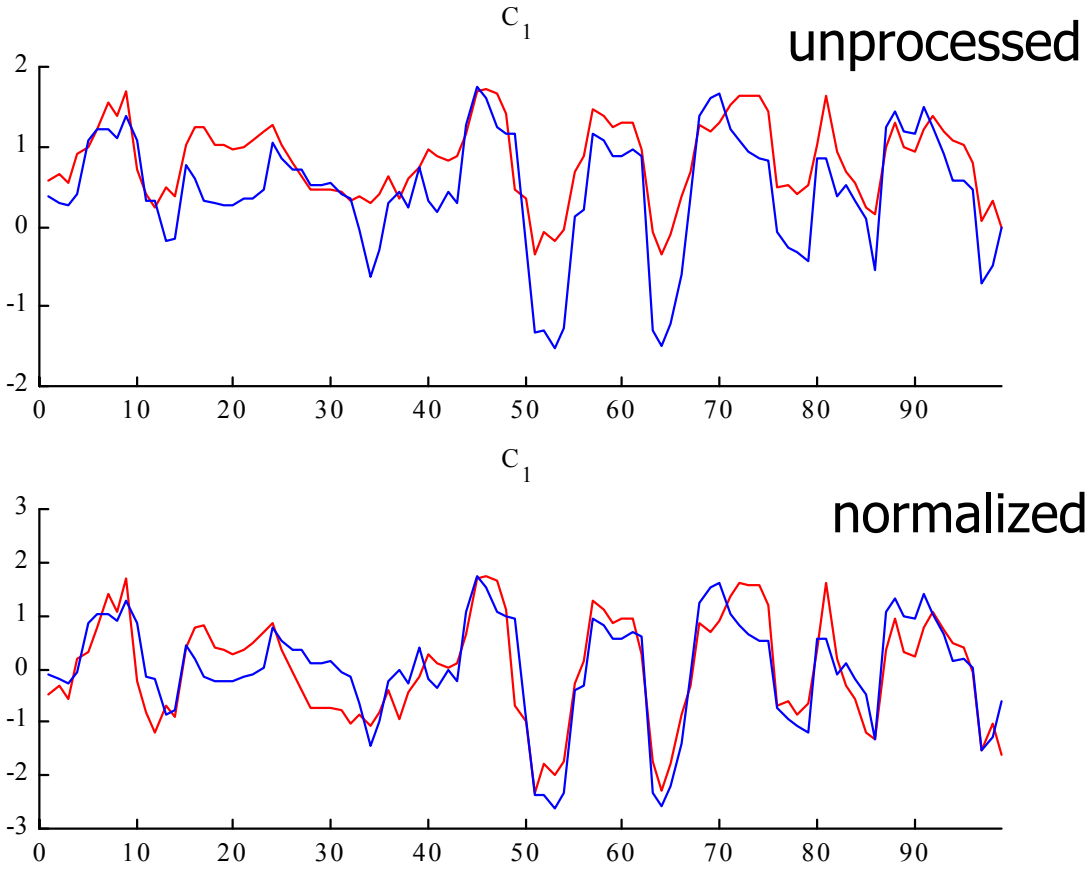
Dual-media Cepstrum Track



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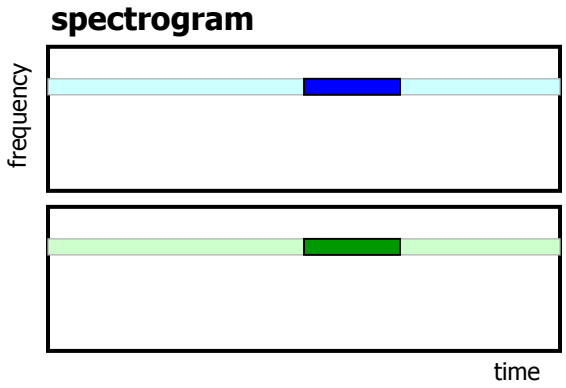
Dual-Channel Mappings

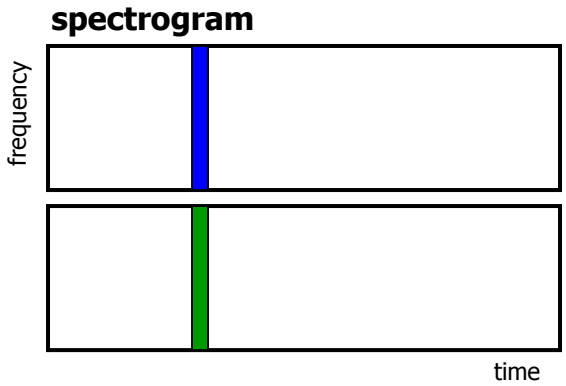
Goal:

- Suppress channel variability
- Preserve phonetic variability



Methods:

- Wiener-like FIR filters
- Spectral basis vectors



Hermansky et. al., ICASSP 95
Malayath et. al., DSP journal, 2000

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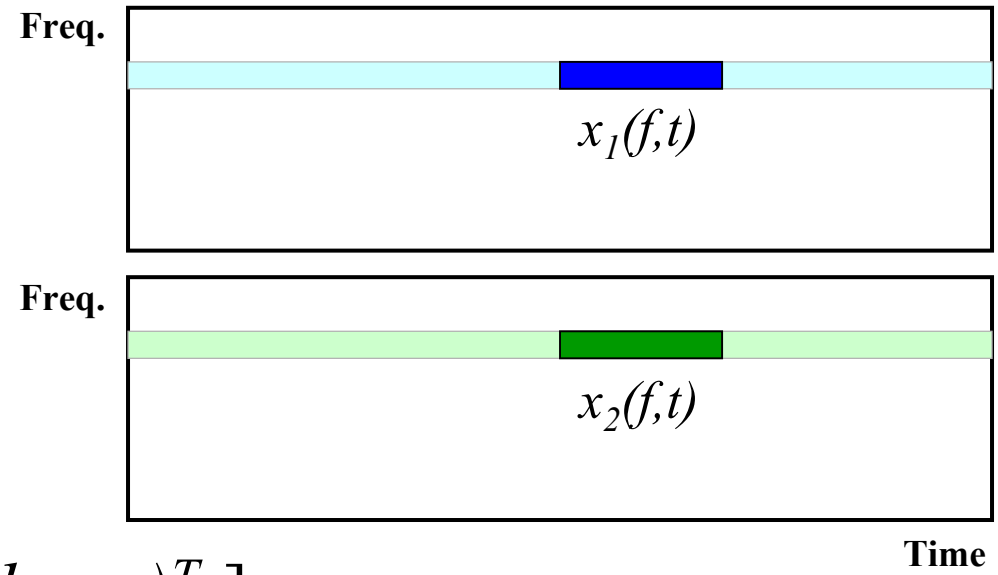
Data-Driven Temporal Filters

$$Y = X^T h$$



$$d = x_1 - x_2$$

$$\Sigma_{ch} = \mathrm{E}\left[(d - \mu_d)(d - \mu_d)^T \right]$$

$$\Sigma_p = \mathrm{E}\left[(\mu_p - \mu)(\mu_p - \mu)^T \right]$$

$$\left[\Sigma_{ch}^{-1} \Sigma_p \right] e = \lambda e$$

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Dual-media Pitch Track

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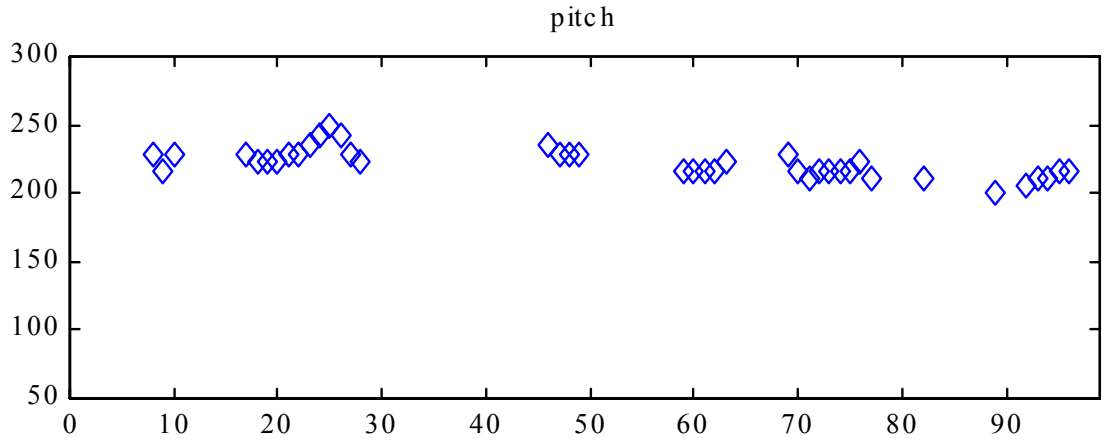

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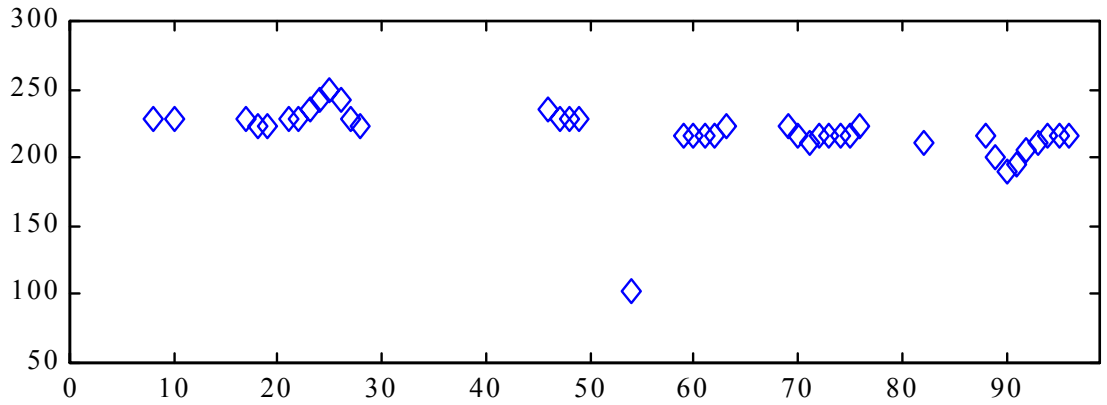

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Cellular Effects

- Spectral and temporal distortions
- Noisy environment
- Speaking style
- Cutoffs
- Miniature microphone

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