Underwater Acoustic Communications

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System model with channel h

- y=h*x+z

- Time-invariant convolution
- Time-varying convolution

$$y(t) = \int_0^{\tau_{max}} h(t;\tau)x(t-\tau)d\tau + z(t),$$

$$y(n) = \sum_{l=0}^{L} h(n;l)x(n-l) + z(n),$$

Matrix form of system model

- Time invariant: Teoplitz matrix h
- Time varying

Least squares channel estimator

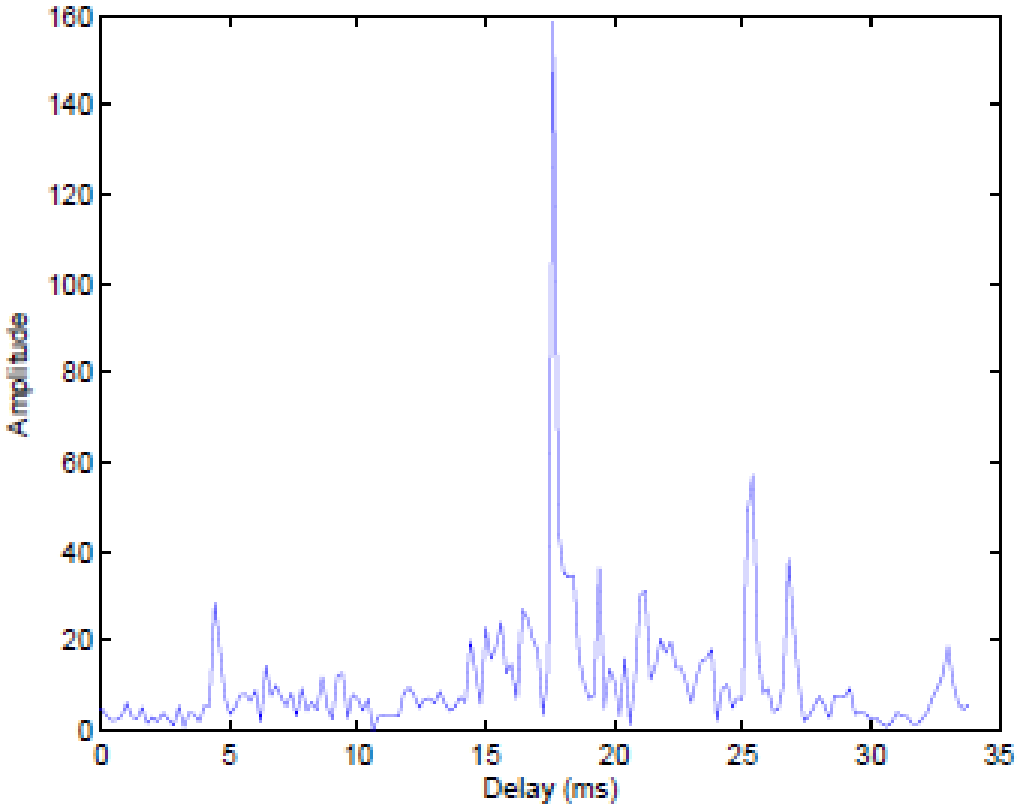
- No channel statistics
- Severely affected by noise

Other channel estimators

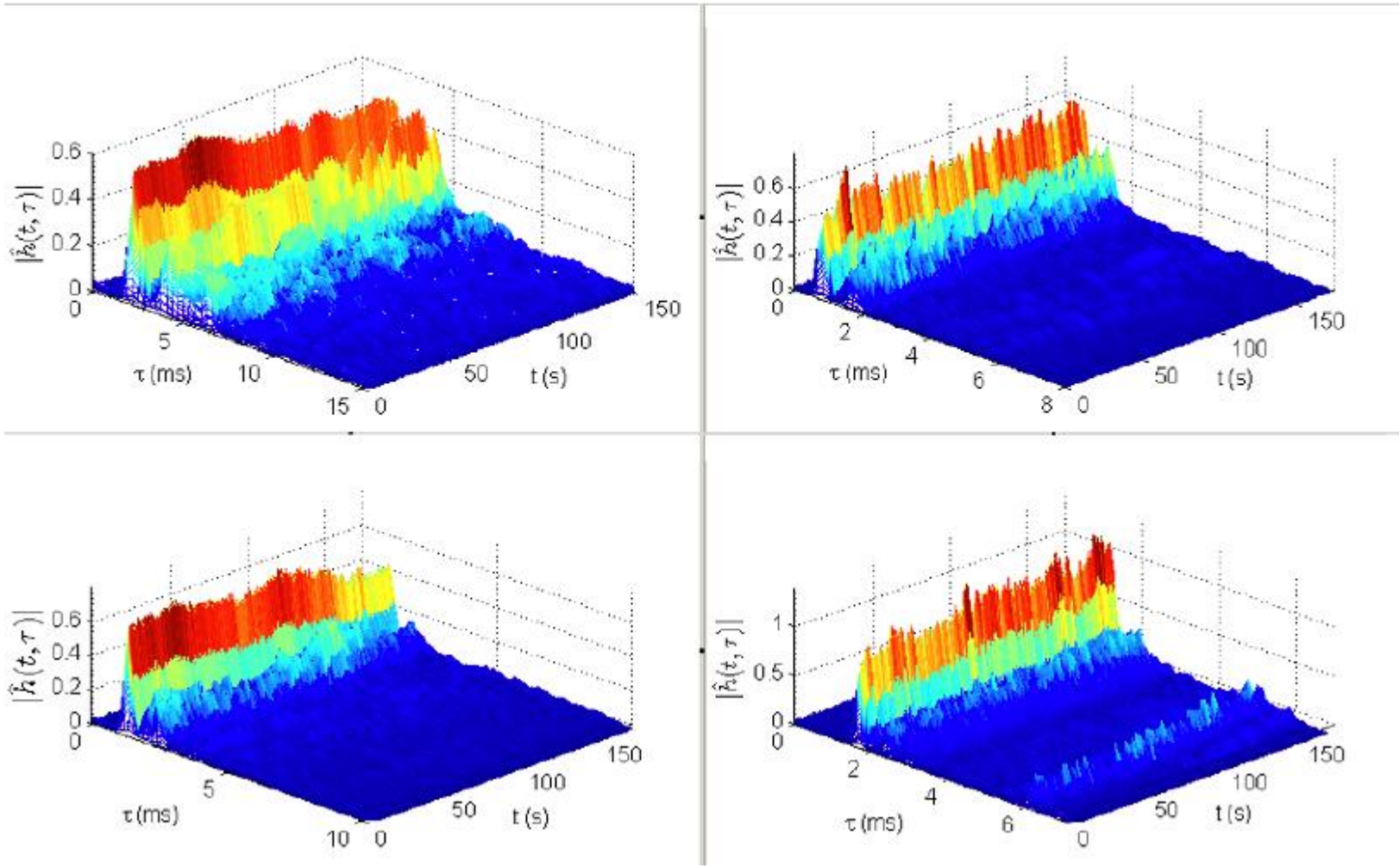
- Minimum mean square error (MMSE)
- Matching pursuit (MP)
- Orthogonal matching pursuit (OMP)

UWA channel

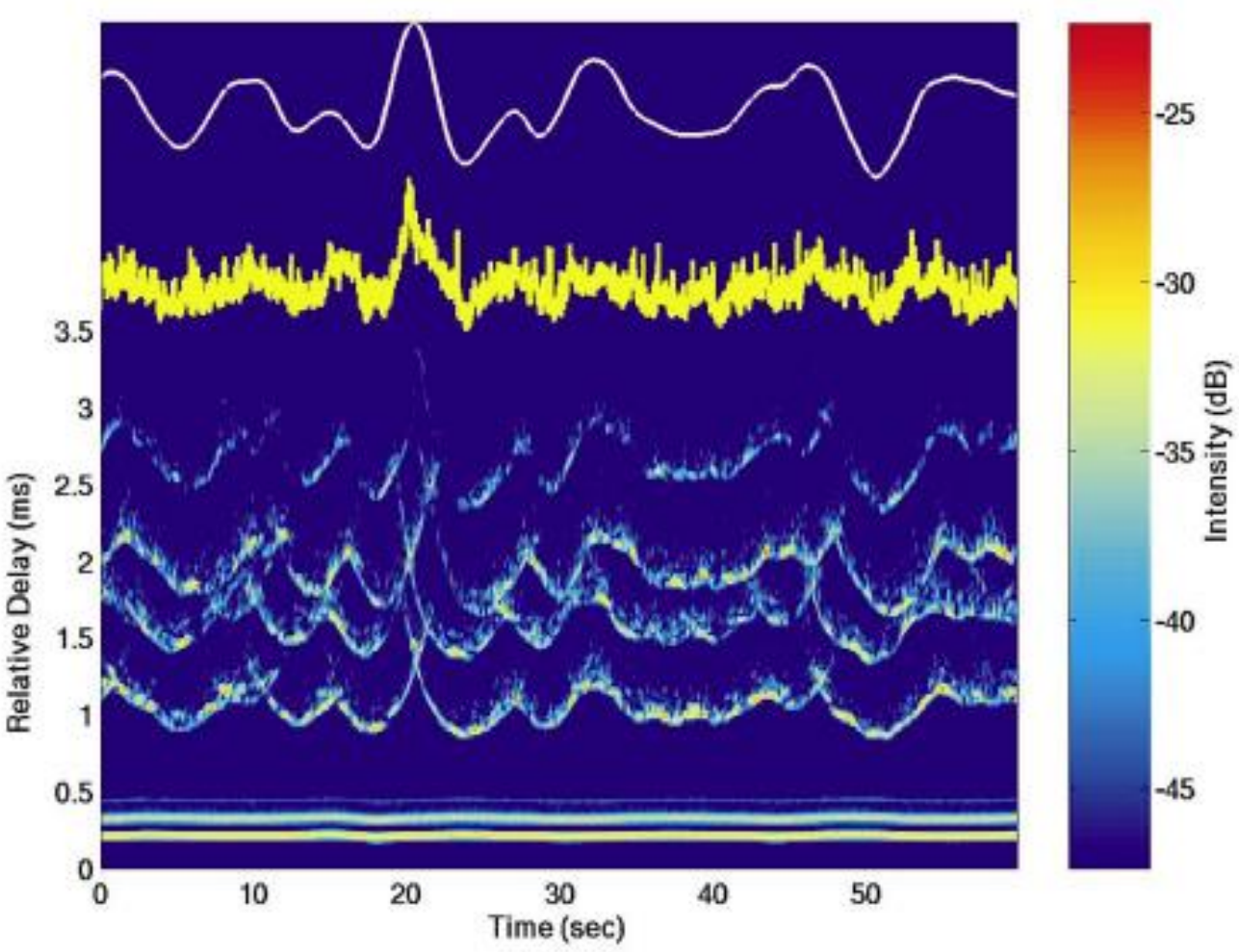
- Gomex08



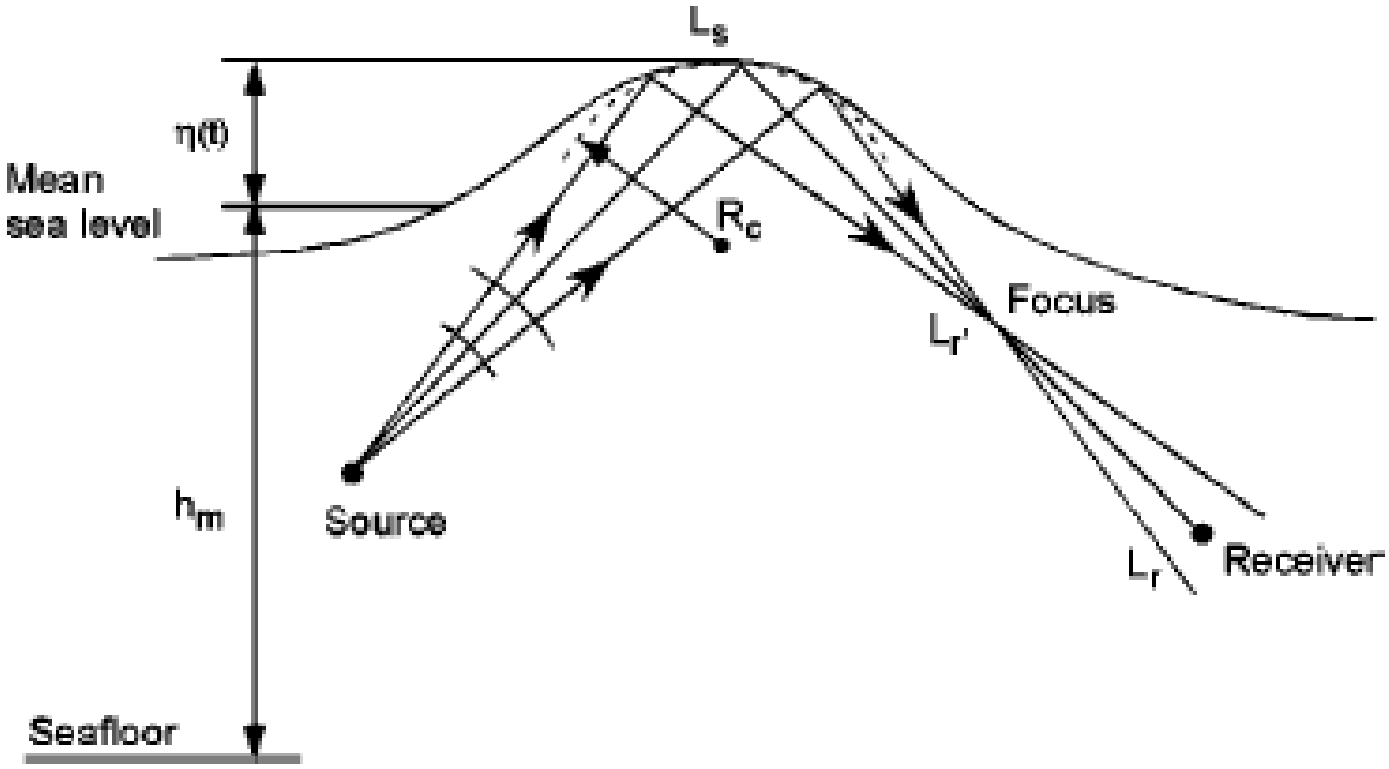
3D time-varying



Surface wave focusing



Physics


L_s
$\eta(t)$
Mean
sea level
R_c
Focus
$L_{r'}$
h_m
Source
L_r
Receiver
Seafloor

Mathematics

$$h(t;\tau):$$

$$h(n;l)$$

Two basic steps of coherent communications

- Channel estimation
- Equalization

Single carrier system

- Channel estimation

$$y(t) = \int_0^{\tau_{max}} h(t;\tau)x(t-\tau)d\tau + z(t),$$

$$y(n) = \sum_{l=0}^{L} h(n;l)x(n-l) + z(n),$$