Parameter Setting

```
clear;  clc;
SNRdB = 1:30;

M = 10000;                                          % sample #
N = 3;                                              % channel #
N0 = 1;                                             % Noise Power
AWGN = zeros(N, length(SNRdB));
CSIR_only = zeros(N, length(SNRdB));
CSIT = zeros(N, length(SNRdB));
truncated_inv = zeros(N, length(SNRdB));
zero_outage = zeros(N, length(SNRdB));
```

Channel Model

$\mathrm{E}\{|h|^2\} = 1$ for comparison

1. Rayleigh Fading with $\sigma^2 = \frac{1}{2}$
2. Nakagami Fading with m = 2, $\sigma^2 = \frac{1}{2}$ (~ 2 antenna diversity)
3. Log Normal Shadowing

```
h = zeros(N, M);
h(1, :) = [random('Rayleigh', sqrt(1/2), [1, M-1]), 0];
h(2, :) = random('Nakagami', 2, 1, [1, M]);
h(3, :) = random('Lognormal', -0.65, 0.8, [1, M]);

channel_gain = mean(abs(h).^2,2)
```

```
channel_gain = 3×1
    0.9981
    0.9892
    0.9529
```

Ergodic Capacity of Channel

$$C = \int_0^{\infty} B\log_2(1+\gamma)\Pr(\gamma)d\gamma = \mathrm{E}\{B\log_2(1+\gamma)\}$$

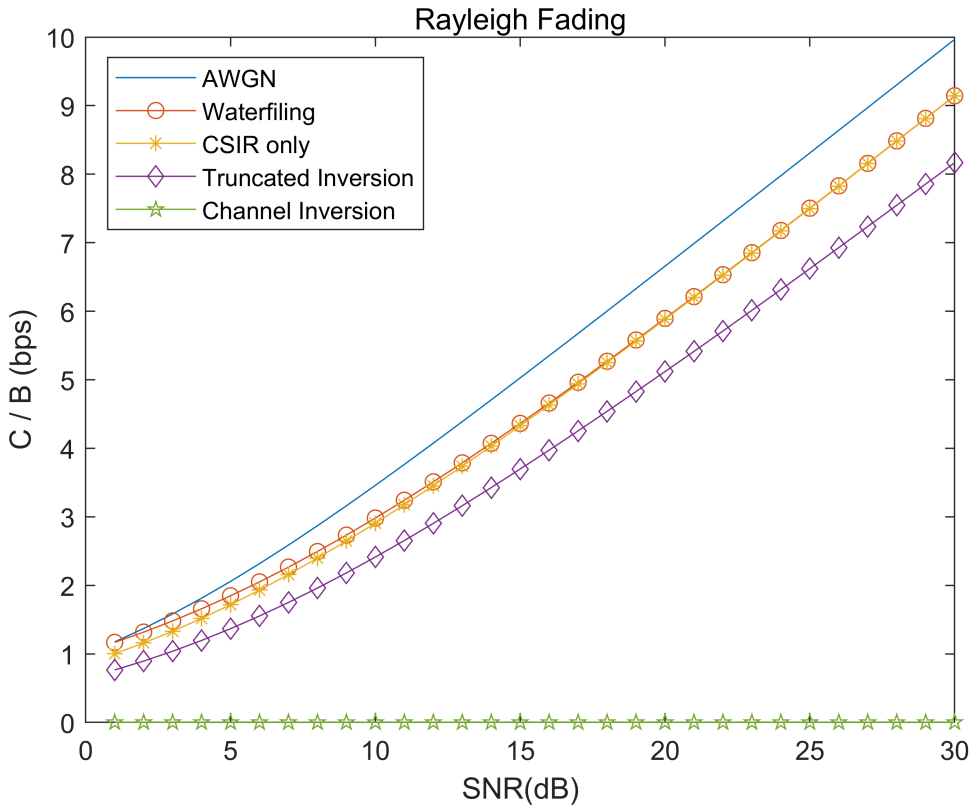
$$\gamma = \mathrm{SNR}\cdot\frac{|h|^2}{\mathrm{E}\{|h|^2\}}$$

```
for n = 1:3
for snrdb = 1:30
snr = 10 ^ (snrdb/10);
```

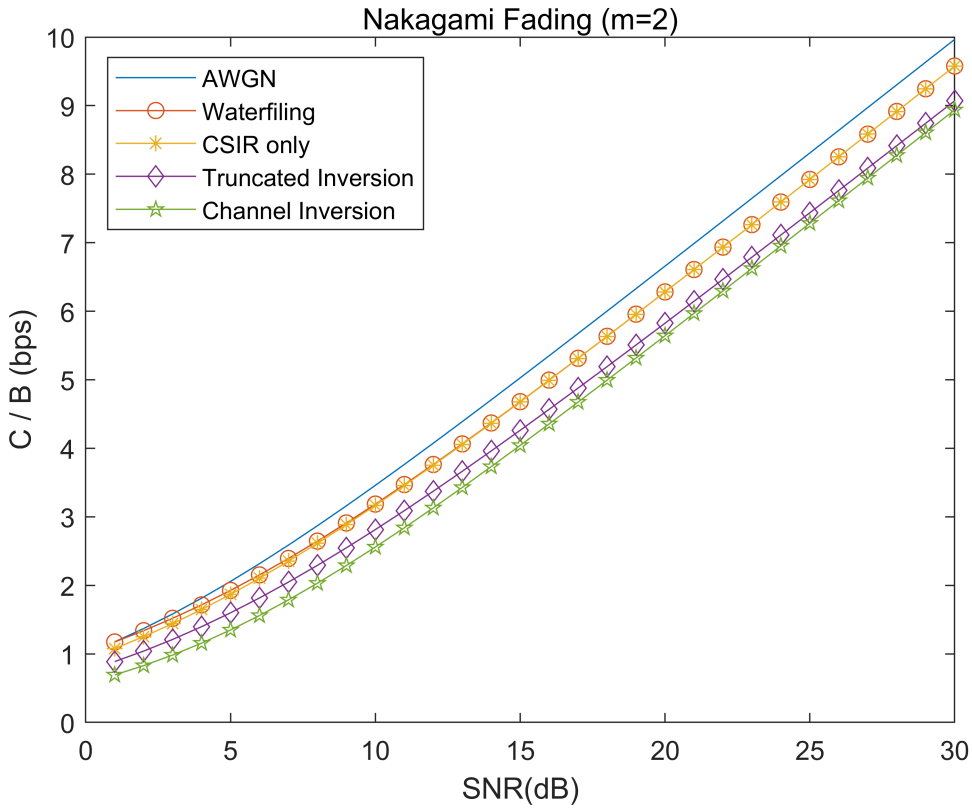
```
AWGN(n, snrdb) = log2(1 + snr);

gamma =  abs(h(n, :)).^2 * snr / mean(abs(h(n, :)).^ 2);

% Waterfilling
P_adapt = waterfill(M, 1 ./ gamma(1: M-1));
CSIT(n, snrdb) = mean(log2(1 + gamma(1:M-1) .* P_adapt));

% Constant Power
CSIR_only(n, snrdb) = mean(log2(1 + gamma));

% Truncated Inversion
Pout = zeros(1, 500);
sigma_0 = zeros(1, 500);
capacity = zeros(1, 500);
for k = 1: 500
    thr = 10 ^ (snrdb/10 - 2 + k * 0.004 );

    Pout(k) = numel(gamma(gamma > thr))/ 10000;
    sigma_0(k) = 1 ./ mean(1 ./ gamma(gamma > thr));
    capacity(k)= Pout(k) * log2(1+ sigma_0(k));
end
truncated_inv(n, snrdb) = max(capacity);



sigma = 1 ./ mean(1 ./ gamma);
zero_outage(n, snrdb) = log2(1+sigma);
end
end
```

Plot Capacity

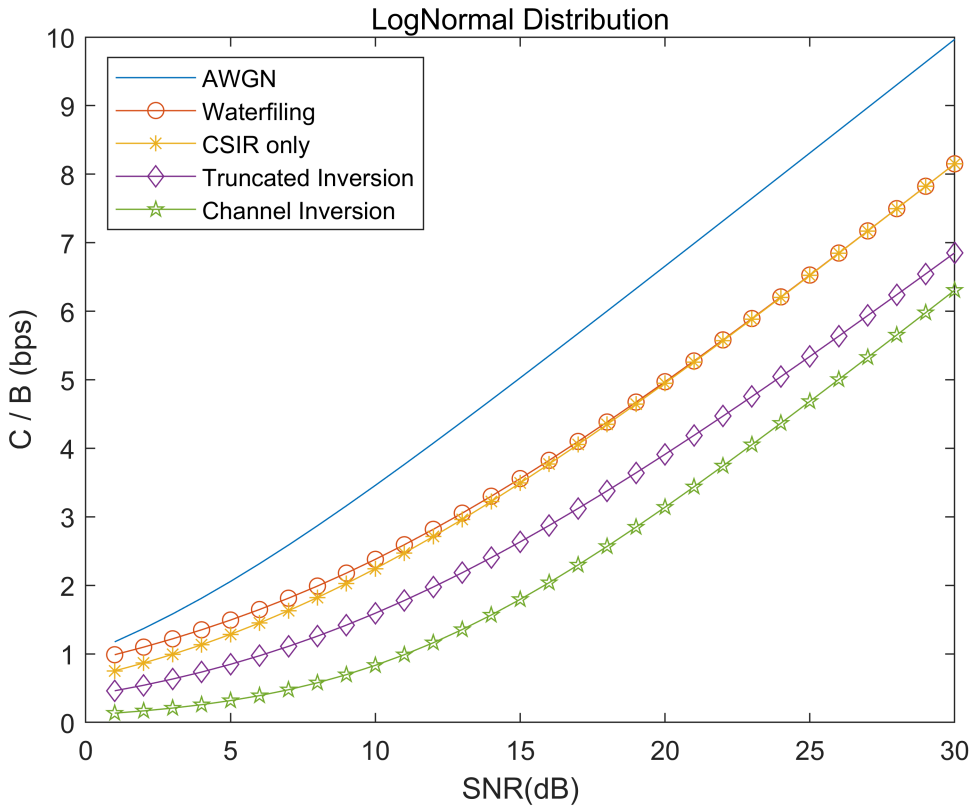
```
capacity_rayleigh = [AWGN(1, :); CSIT(1, :); CSIR_only(1, :); truncated_inv(1, :); zero_outage(
capacity_nakagami = [AWGN(2, :); CSIT(2, :); CSIR_only(2, :); truncated_inv(2, :); zero_outage(
capacity_lognormal = [AWGN(3, :); CSIT(3, :); CSIR_only(3, :); truncated_inv(3, :); zero_outage


markers = {'none', 'o', '*', 'diamond', 'pentagram'};
name = {'AWGN', 'Waterfiling', 'CSIR only', 'Truncated Inversion', 'Channel Inversion'};

plt = plot(SNRdB, capacity_rayleigh);
set(plt, {'Marker'}, markers(:))
title('Rayleigh Fading')
xlabel('SNR(dB)')
ylabel('C / B (bps)')
legend(name, 'Location', 'northwest')
```




```
figure
plt2 = plot(SNRdB, capacity_nakagami);
set(plt2, {'Marker'}, markers(:))
title('Nakagami Fading (m=2)')
xlabel('SNR(dB)')
ylabel('C / B (bps)')
legend(name, 'Location', 'northwest')
```




```
figure
plt3 = plot(SNRdB, capacity_lognormal);
set(plt3, {'Marker'}, markers(:))
title('LogNormal Distribution')
xlabel('SNR(dB)')
ylabel('C / B (bps)')
legend(name, 'Location', 'northwest')
```


LogNormal Distribution
AWGN
Waterfiling
CSIR only
Truncated Inversion
Channel Inversion
C / B (bps)
SNR(dB)
0
1
2
3
4
5
6
7
8
9
10
0
5
10
15
20
25
30