Fig. 11. A family of lower bounds for the sum capacity of an AWGN channel using different $\gamma$'s and their envelope versus number of users $n$ when $E_b/N_0 = 8dB$ and the spreading gain is 64.

Fig. 12. The sum capacity lower bound versus the number of users for binary input and binary signature matrix when all the probabilities are equal to 1/2 for $m = 16$ and $\eta = 8dB$.

D. Asymptotic Analysis of CDMA Systems

The asymptotic analysis of CDMA channels is referred to the case in which the number of users and the spreading factor tend to infinity while their ratio ($\beta$) remains constant. The asymptotic case which is also called large scale system [39]–[42], [57], is being studied by many recent works. The base of these works are related to replica theory derived from statistical