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TIME-CORRELATED MIMO RAYLEIGH BLOCK-FADING CHANNELS USING DIFFERENTIAL FEEDBACK

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ABSTRACT:
In this paper, we discussed the Channel Differential Channel (CSI) feedback feedback for a Multiple Output Multiple System (MIMO) over time, related to the Rayleigh Block Block Channels. In particular, we draw the minimum differential feedback rate in closed form in the presence of channel estimation errors and quantization distortion. With the feedback channel capacity constraint, we further study ergodic capacity in a periodic feedback system in terms of minimum differential feedback difference and feedback range. Through the theoretical analysis we find that there is an optimum differential feedback range to reach maximum ergodic capacity. Analytical results are verified by simulations in a periodic differential differential feedback system using the water filler preconditioner and the Lloyd quantification algorithm.
Keywords: MIMO, differential feedback rate, temporal correlation, feedback interval, ergodic capacity.

I INTRODUCTION

Channel Information (CSI) Feedback Problems have been intensively studied due to their potential advantages for multiple multiple input systems (MIMOs) [1]. CSI can be used by a variety of channel adapters (for example, water load, beamforming, forced zero interference alignment, etc.) on the transmitter side to improve spectral efficiency and robustness, especially for systems operating in split mode frequency division (FDD). Because the ability of the feedback channel is usually limited, infinite CSI feedback is difficult to perform in practice. Therefore, it is important to examine how the amount of feedback that will signal overload is reduced to conform to the uplink channel constraint. Consequently, the reduction in CSI feedback has attracted a lot of attention in recent years [1], [2].In particular, when the wireless channel experiences time fade [3], typically represented by a randomized Markov [4] - [6] process, the amount of CSI feedback can be significantly reduced. In [7], some feedback reduction schemes have been reviewed, considering that the best option is

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the loss compression sequence that exploits the properties of the fading process. In [8] and [9], proposed codebook commands and differential feedback codes have been proposed. In [10], related fading channel over time was modeled as Markov chain finite states, and the feedback rate was reduced by ignoring the conditions that occur with little probability. In [11] and [12], a prediction vector quantization scheme was proposed, assuming that the previous CSI quantization was known. In [13], variable length codes were applied to reduce the response rate. Despite many researches on the practice of reducing feedback schemes, as far as the authors' knowledge is concerned, the lower limit compression ratings and the minimum reversed differential speed required to ensure the accuracy of quantized CSI have not been well studied fading blocks of related MIMO blocks Rayleigh.In order to optimize feedback design, the relationship between system capacity and CSI feedback rate was studied in [14] - [17]. Lower and higher limits of the feedback rate which gain a positive gain compared to the openloop systems. The optimal response speed in a non-memory periodic feedback system has been studied in [20] when the CSI is powered independently at all times. However, differential time feedback is not taken into account. Without losing any generality, in this article we consider a general point-to-point MIMO system with differential CSI periodic feedback over time The Rayleigh block fading channels investigate the relationship between differential feedback capacity and feedback speed with the capacity limitation of the feedback channel. The main contributions of this document can be briefly summarized as follows:

1) We perform the minimum expression of differential differencing for time-related MIMO Rayleigh melting channels, taking into account both channel estimation errors and channel quantization distortions, which are assumed to be independent and distributed complex Gaussian variables identical way (iid).

2) We studied the relationship between the ergodic capacity and the feedback range with the restriction of the feedback channel capacity in a periodic differential feedback system. We also show that there is an optimal range of feedback to achieve maximum ergodic capacity.

3) Present the approximate optimal feedback ranges and verify the theoretical results in a practical differential feedback system using the water filling preconditioner and the Lloyd quantification algorithm.

II. PROPOSED SYSTEM

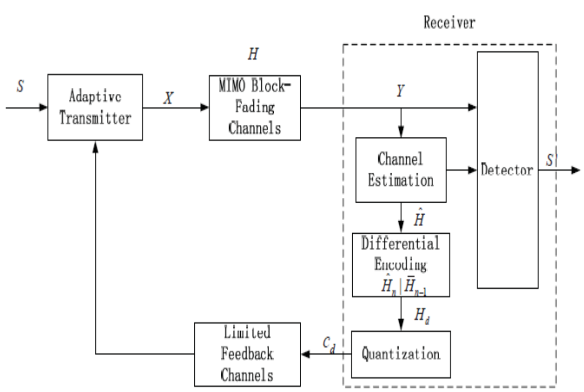

Fig. 1. System model of the differential feedback over time-correlated MIMO Rayleigh block-fading channels.

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Time-Correlated MIMO Rayleigh Block Fading Channel Model:

We consider MIMO Rayleigh block fading channels, where the channel fading matrix remains constant within a fading block and varies from one to another. There are N_t transmit antennas and N_r receive antennas. The received signals can be expressed in a vector form

$$\mathbf{y} = \mathbf{H}\mathbf{x} + \mathbf{n}_0, \quad (1$$

where $y = [y_1, y_2, \cdots, y_{N_r}]^T$ denotes a $N_r \times 1$ received signal vector,H is a $N_r \times N_t$ channel fading matrix with independent entries obeying complex Gaussian distribution $\mathcal{CN}(0, \sigma^2_h)$,$x = [x_1, x_2, \cdots, x_{N_t}]^T$ represents a $N_t \times 1$ transmitted signal vector, and n0 is a $N_r \times 1$ noise vector whose entries are i.i.d. complex Gaussian variables satisfying $\mathcal{CN}(0, \sigma^2_0)$.The time-correlated channel can be represented by the firstorder Autoregressive model (AR1) [6], and the channel fading matrix can be written as

$$\mathrm{H}_n = \alpha \mathrm{H}_{n-1} + \sqrt{1-\alpha^2}\mathrm{W}_n, \quad (2)$$

where H_n denotes the n-th channel fading matrix, W_n is a noise matrix, which is independent of H_{n-1}, and the entries are i.i.d. complex Gaussian variables with $\mathcal{CN}(0, \sigma^2_h)$. The parameter α is time correlation coefficient, which is given by the zero-order Bessel function of first kind, i.e., $\alpha = J_0(2\pi f_d \tau)$ [3], where f_d stands for the maximum Doppler frequency and τ denotes the time interval between consecutive feedback messages. In the block-fading system, the feedback interval can be calculated as $T = \tau/t_b$, where t_b represents the duration of every block.The CSI is estimated by the receiver using orthogonal pilots. Without loss of generality, in this paper, the maximum likelihood (ML) criterion is employed to perform channel estimation, and the resulting estimated channel matrix can be expressed in an equivalent form as

$$\hat{\mathrm{H}} = \mathrm{H} + \mathrm{H}_e, \quad (3)$$

where $\hat{\mathrm{H}}$ denotes the channel estimation matrix, whose entries are i.i.d. complex Gaussian variables following a distribution $\mathcal{CN}(0, \sigma^2_{\hat{h}})$, H is the actual channel fading matrix, He stands for the channel estimation error matrix, which is independent of H, with i.i.d. entries following a complex Gaussian distribution $\mathcal{CN}(0, \sigma^2_e)$, and $\sigma^2_e = \sigma^2_{\hat{h}} - \sigma^2_h$. With ML channel estimation, the estimation error He can be decomposed into two terms as

$$\mathrm{H}_e = \left(1 - \frac{\sigma^2_h}{\sigma^2_{\hat{h}}}\right)\hat{\mathrm{H}} - \Psi, \quad (4)$$

with

$$\Psi = \mathrm{H} - \frac{\sigma^2_h}{\sigma^2_{\hat{h}}}\hat{\mathrm{H}}, \quad (5)$$

$$\mathrm{H} = \frac{\sigma^2_h}{\sigma^2_{\hat{h}}}\hat{\mathrm{H}} + \Psi. \quad (6)$$

III. RESULTS

This section will present the simulation results and performance analysis of our proposed scheme. The presentation focuses on the recovery performance of our scheme in various situations.

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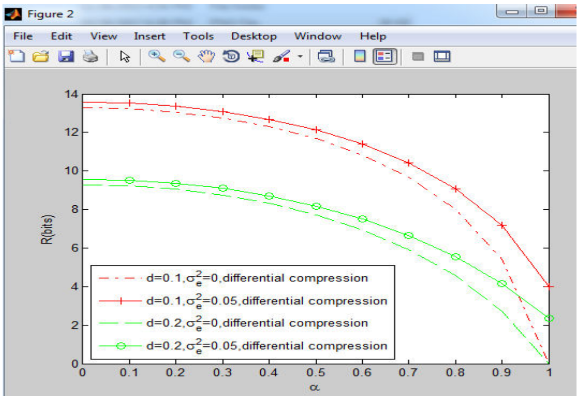

Fig. 2. The relationship between the minimum differential feedback rate and time correlation for $Nr = 2$, $Nt = 2$, $\sigma^2_e = 0$, 0.05, and $d = 0.1$, 0.2.

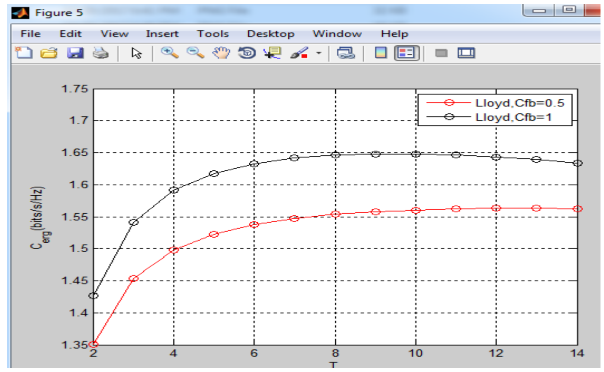

Fig. 5. The relationship between the ergodic capacity and feedback interval with Lloyd algorithm in AR1 model for $Nr = 2, Nt = 2$, SNR = 0 dB, $L = 100$, and $fD = 9.26$ Hz.

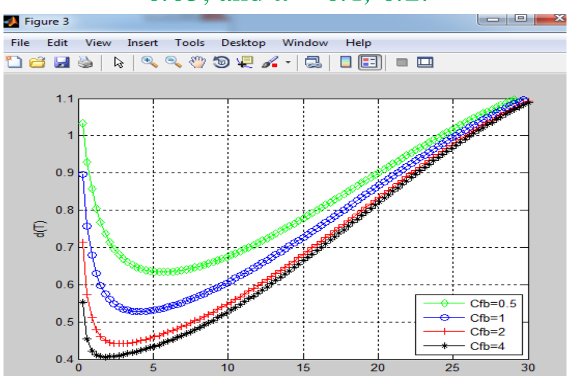

Fig. 3. The relationship between the distortion of CSI and the feedback interval for $Nr = 2$, $Nt = 2$, $\sigma^2_h = 1$, and $\sigma^2_{\hat{h}} = 1.2$.

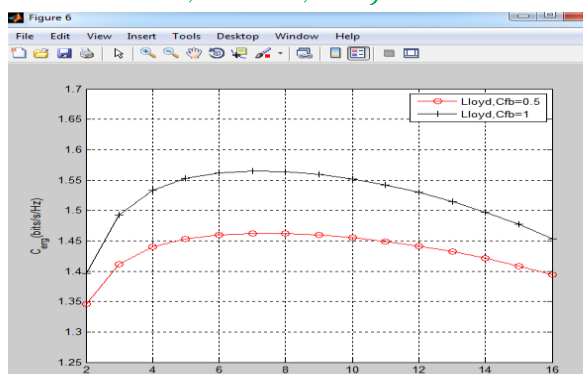

Fig. 6. The relationship between the ergodic capacity and feedback interval with Lloyd algorithm using Jakes' model for $Nr = 2$, $Nt = 2$, SNR = 0 dB, $L = 100$, and $fD = 9.26$ Hz.

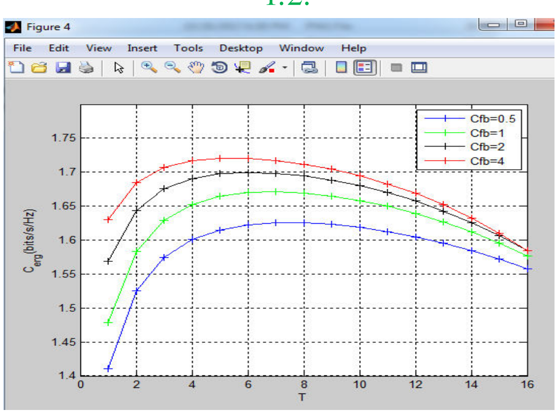

Fig. 4. The relationship between the ergodic capacity and feedback interval for $Nr = 2$, $Nt = 2$, SNR = 0 dB, $L = 100$, and $fD = 9.26$ Hz.

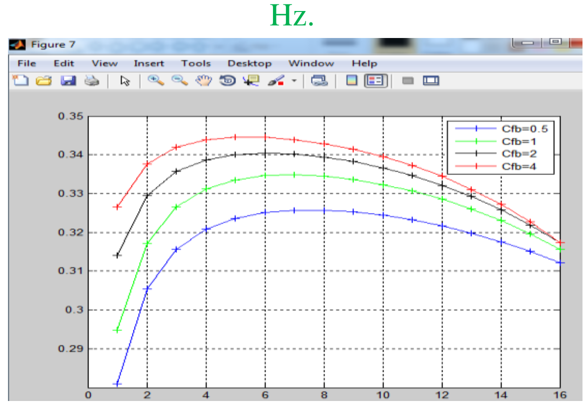

Fig. 4. The relationship between the ergodic capacity and feedback interval for $Nr = 2$, $Nt = 2$, SNR = 0 dB, $L = 100$, and $fD = 9.26$ Hz. Using PSK Modulation signal input.

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IV. CONCLUSION

In this paper, we derived the minimum differential return rate for Rayleigh-related blocking channels over time considering channel estimation errors, which is the lower limit of feedback compression with temporal correlation. In addition, subject to the restriction of the feedback channel by fade block, the relationship between the closed circuit ergodic capacity and the feedback range is examined. We find that closed-loop ergodic capacity is a concave monotone function of the feedback range and there is an optimum feedback range for maximum ergodic capacity. The simulation results of a practical differential feedback system with the water filler preconditioner (note that another precodel can still be easily applied) and the Lloyd quantization algorithm is provided to validate our theoretical results.

V. REFERENCES

[1] C. Simon, R. de. Francisco, D. T. M. Slock, and G. Leus, "Feedback compression for correlated broadcast channels," *2007 IEEE Symp. Commun. Veh. Technol. Benelux*.

[2] K. Kim, H. Kim, and D. J. Love, "Utilizing temporal correlation in multiuser MIMO feedback," in *Proc. 2008 IEEE ACSSC*.

[3] C. Simon and G. Leus, "Feedback reduction for spatial multiplexing with linear precoding," in *Proc. 2007 IEEE ICASSP*.

[4] D. Zhang, J. Xie, G. Wei, and J. Zhu, "Capacity and feedback rate in closed-loop MIMO wireless systems," in *Proc. 2004 IEEE ICCS*.

[5] G. M. Güvensen and A. O. Yilmaz, "An upper bound for limited rate feedback MIMO capacity," *IEEE Trans. Wireless Commun.,* vol. 8, no. 6, pp. 2748–2754, June 2009.

[6] K. N. Lau, Y. Liu, and T. A. Chen, "On the design of MIMO blockfading channels with feedback-link capacity constraint," *IEEE Trans. Commun.,* vol. 52, no. 1, pp. 62–70, Jan. 2004.

[7] A. D. Dabbagh and D. J. Love, "Feedback rate-capacity loss tradeoff for limited feedback MIMO systems," *IEEE Trans. Inf. Theory,* vol. 52, no. 5, pp. 2190–2202, May 2006.

[8] D. Zhang, G. Wei, J. Zhu, and Z. Tian, "On the bounds of feedback rates for pilot-assisted MIMO systems," *IEEE Trans. Veh. Technol.,* vol. 56, no. 4, pp. 1727–1736, July 2007.

[9] W. Li, M. Ma, and B. Jiao, "Comments on 'On the bounds of the feedback rates for pilot-assisted MIMO systems'," *IEEE Trans. Veh.Technol.,* vol. 58, no. 8, pp. 4657–4660, Oct. 2009.

[10] K. Huang, B. Mondal. R. W. Heath, Jr., and J. G. Andrews, "Multiantenna limited feedback for temporally-correlated channels: feedback compression," in *Proc. 2006 IEEE GLOBECOM*.

[11] C. Simon, R. de. Francisco, D. T. M. Slock, and G. Leus, "Feedback compression for correlated broadcast channels," *2007 IEEE Symp. Commun. Veh. Technol. Benelux*.

[12] K. Kim, H. Kim, and D. J. Love, "Utilizing temporal correlation in multiuser MIMO feedback," in *Proc. 2008 IEEE ACSSC*.

[13] C. Simon and G. Leus, "Feedback reduction for spatial multiplexing with linear precoding," in *Proc. 2007 IEEE ICASSP*.

[14] D. Zhang, J. Xie, G. Wei, and J. Zhu, "Capacity and feedback rate in closed-loop MIMO wireless systems," in *Proc. 2004 IEEE ICCS*.

[15] G. M. Güvensen and A. O. Yilmaz, "An upper bound for limited rate feedback MIMO capacity," *IEEE Trans. Wireless Commun.,* vol. 8, no. 6, pp. 2748–2754, June 2009.

[16] K. N. Lau, Y. Liu, and T. A. Chen, "On the design of MIMO blockfading channels with feedback-link capacity constraint," *IEEE Trans. Commun.,* vol. 52, no. 1, pp. 62–70, Jan. 2004.

[17] A. D. Dabbagh and D. J. Love, "Feedback rate-capacity loss tradeoff for limited feedback MIMO systems," *IEEE Trans. Inf. Theory,* vol. 52, no. 5, pp. 2190–2202, May 2006.

[18] D. Zhang, G. Wei, J. Zhu, and Z. Tian, "On the bounds of feedback rates for pilot-assisted MIMO systems," *IEEE Trans. Veh. Technol.,* vol. 56, no. 4, pp. 1727–1736, July 2007.

[19] W. Li, M. Ma, and B. Jiao, "Comments on 'On the bounds of the feedback rates for pilot-assisted MIMO systems'," *IEEE Trans. Veh. Technol.,* vol. 58, no. 8, pp. 4657–4660, Oct. 2009.

[20] W. Li, M. Ma, and B. L. Jiao, "Optimization of feedback for adaptive MIMO transmissions over time varying channels," *Wireless Personal Commun.,* vol. 54, no. 4, pp. 579–590, July 2009.

[21] V. R. Cadambe and S. A. Jafar, "Interference alignment and degrees of freedom of the K-user interference channel," *IEEE Trans. Inf. Theory,* vol. 54, no. 8, pp. 3425–3441, Aug. 2008.

[22] J. Thukral and H. Bolcskei, "Interference alignment with limited feedback," in *Proc. 2009 IEEE ISIT*.

[23] D. Samardzijia and N. Mandayam, "Pilot-assisted estimation of MIMO fading channel response and achievable data rates," *IEEE Trans. Signal Process.,* vol. 51, no. 11, pp. 2882–2890, Nov. 2003.

[24] Y. Sun and M. L. Honing, "Asymptotic capacity of multicarrier transmission with frequency-selecive fading and limited feedback," *IEEE Trans. Inf. Theory,* vol. 54, no.7, pp. 2879–2902, July 2008.

[25] R. J. McEliece, *The Theory of Information and Coding,* 2nd edition. Cambridge University Press, 2002.

[26] S. P. Lloyd, "Least-square quantization in PCM," *IEEE Trans. Inf. Theory,* vol. 28, pp. 129–137, Mar. 1982.

[27] P. Xia, S. Zhou, and G. B. Giannakis, "Achieving the Welch bound with difference sets," *IEEE Trans. Inf. Theory,* vol. 51, no. 5, pp. 1900–1907, May 2005.