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Optimization strategy of mobile data transmission based on optimal crowd feedback

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Abstract

In order to eliminate the factors that restrict the performance of wireless network data transmission, we proposed the optimal control mechanism of wireless network data transmission. The proposed mechanism solves the intelligence problem of the feedback loop, the mobility of relay nodes, and the feedback of the receiving end. On the one hand, to eliminate the external interference factors, we established an optimal feedback loop control system between the sender and the receiver. On the other hand, in the time linear region, the crowd feedback module is added to the optimal feedback closed-loop control system based on the linear weight. On the basis of the above schemes, we proposed an adaptive optimization model of mobile data transmission. The experiments compared the proposed optimal crowd feedback optimal control scheme with the optimization strategy of the data transmission. From the results of system efficiency and system throughput performance, the proposed optimal crowd feedback optimal control scheme has an obvious advantage.

Keywords: Control optimization, Mobility management, Wireless data transmission, Crowd feedback

1 Introduction

The diversity of [1] and data services in wireless transmission environment [2] makes the quality of wireless transmission data decrease. Wireless transmission system performance is not stable. These problems seriously affect the quality of the user experience [3]. These issues restrict the way [4] and operating costs of mobile service carriers. In order to solve these problems, the academic and industrial circles have studied the wireless communication protocol [5–8], the wireless data packet [9, 10], the transmission performance control optimization [11, 12], and so on.

Jin M proposed a remote wireless transparent transmission protocol for meeting the requirements of the Internet of Things-based intelligent remote monitoring system for construction vehicles on the real time [5]. The distance-sensitive wireless communication protocol was proposed in an article [6] to hearing protectors equipped with in-ear microphones. Chaturvedi A et al. studied the secure wireless communication protocol with the Diffie-Hellman key exchange scheme [7]. The link performance of intra-satellite networking was analyzed and discussed [8] for receiving sensitivity in each model.

The cellular/infostation integrated network was considered by the authors of an article [9] that supports on-demand data service delivery. The novel approaches was proposed in an article [10] that are based on data envelopment analysis (DEA) to further optimize energy consumption in wireless multicast networks.

The random wireless sensor networks were considered, where nodes are distributed randomly and form clusters to transmit the packets to relay clusters using cooperative multi-input-multi-output technique [11]. A simple and effective method is demonstrated to overcome the frequency splitting for an optimal efficiency [12].

The rest of the paper is organized as follows. Section 2 gives the optimal feedback model. Section 3 discussed the optimization strategy of mobile data transmission with crowd feedback. The algorithm analysis results have

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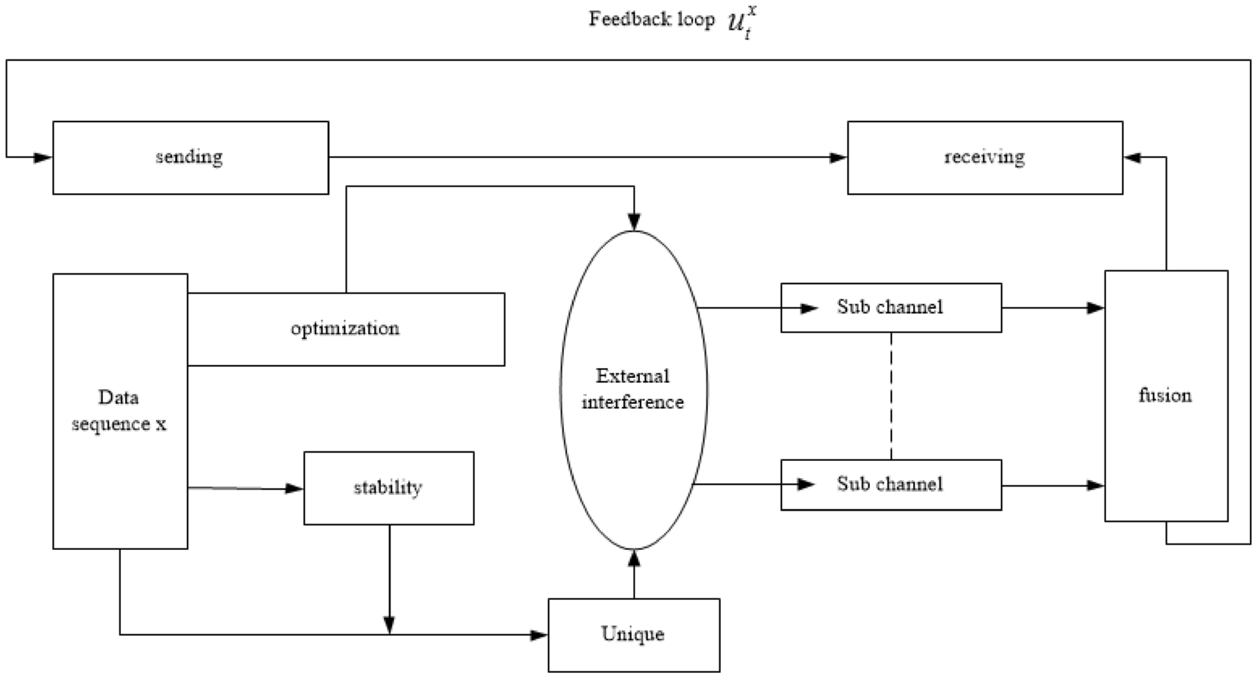

Fig. 1 Optimal feedback loop

been in Section 4. Finally, the Section 5 concludes this paper.

2 Optimal feedback model

The linear data transmission system for wireless communication networks is described as follows:

$$\begin{cases} y(x) = H(t)x(t) + F(t)d(s) \\ y(t) = F(x)s \end{cases} \tag{1}$$

where x said emission signal intensity. t denotes the data transmission time. H (t) said linear vector data transmission. Function F (t) said linear data transmission control vector. s is the linear transmission data sequence. d (s) denotes the size of the data. y (x) indicates the transmitting power signal. y (t) represents the linear time on the total transmit power.

Wireless data transmission is subject to various external disturbances, such as obstacles reflection, building diffraction, ground absorption, and other factors. An optimal feedback loop is formed between the sender and the receiver, which is the key to eliminate the interference factors. The formula (2) describes the optimal feedback closed-loop control systems.

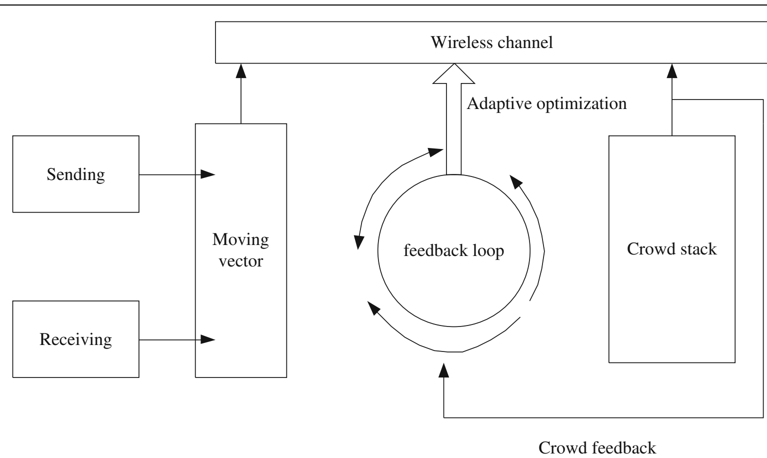

Fig. 2 Adaptive optimization model of mobile data transmission based on crowd

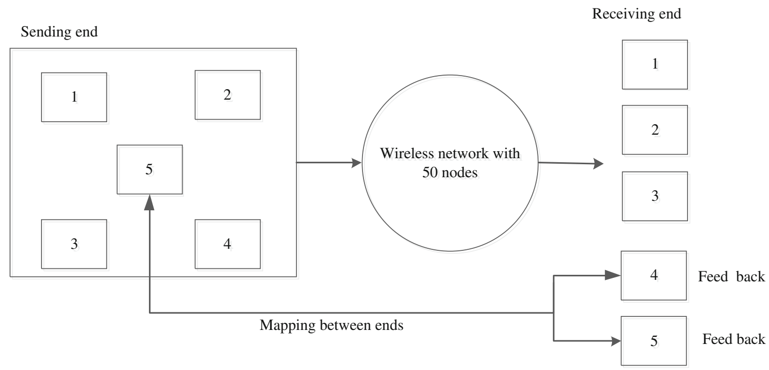

Fig. 3 Experimental architecture

$$\begin{cases} P(t)+P(s)H(t)-F(x)y(t)\geq 0 \\ P(x)\leq d(s) \\ \dfrac{u_t^x = -H(s)^{-1}F(d)}{\sum\limits_{i=1^{N(x)}} s(i)} \end{cases} \tag{2}$$

Here, P (t) is the linear data in time domain. N (x) represents the number of symbols in the data sequence x. u_t^x is the feedback loop of the data sequence x in the time domain. The constraint condition $P(t) + P(s)H(t) - F(x)y(t) \geq 0$ can guarantee the stability of wireless data transmission. The constraint condition $P(x) \leq d(s)$ can guarantee the uniqueness and optimality of the closed loop (see Fig. 1).

3 Optimization strategy of mobile data transmission with crowd feedback

The optimal feedback closed-loop control system is composed of m data packets. k represents the number of packets. The system transmission efficiency η can be obtained from the formula (3).

$$\begin{cases} \eta = \dfrac{\sum\limits_{k=1}^{m} d(k)}{d(s)}, w_{\mathrm{L}} = 0 \\ \eta = \dfrac{\sum\limits_{k=1}^{m} d(k)}{P(x)}, w_{\mathrm{L}} > 0 \end{cases} \tag{3}$$

According to the different time domain linear weighting w_{L}, the solution is divided into two kinds. According to the formula (2), it can be known that the optimal system efficiency can be obtained when the w_{L} is greater than 0.

In order to keep the probability of w_{L} be greater than 0, we design the crowd feedback module in the optimal feedback loop control system. The value feedback vector x_{CR} can be obtained by the formula (4).

$$\begin{cases} x_{\mathrm{CR}} = \int\limits_{t\to T} x(t) + \dfrac{H(x)-\|F(t)\|}{\sum\limits_{k=1}^{m} d(k)} d(k) = \dfrac{Fd}{P(x)-\frac{1}{2}H(s)^{-1}} \end{cases} \tag{4}$$

The crowd feedback system efficiency of the transmission after the optimization (see Fig. 2) can be computed with the formula (5).

$$\eta_{\mathrm{CR_{OP}}} = \frac{\sum\limits_{k=1}^{m} d(k)}{w_{\mathrm{L}}\|F(x)\|} \cdot \frac{\sqrt{d(x)}}{P(x)} \tag{5}$$

After optimization, the total length of the data sequence $L_{\mathrm{CR\_OP}}$ can be calculated by the formula (6).

$$L_{\mathrm{CR_{OP}}} = \left\| \sum_{k=1}^{m} N(x_k) \right\| \frac{w_{\mathrm{L}} \sum\limits_{k=1}^{m} d(k)}{\|F(x)\|^2} \tag{6}$$

4 Algorithm evaluation results

The data transmitting end of the experimental platform is a cluster composed of five servers. The receiver runs five Linux virtual systems in a parallel operation. Between the transmitter and the receiver is a wireless communication network composed of 50 mobile nodes. The mapping relationship between the transmitter and two virtual systems of the receiver is an end to end mapping.

Table 1 Experimental settings

Parameters	Value	Parameters	Value
CPU	8 core	Memory	32 GB
OS	CentOS6.5	Hard disk space size	1 TB
Driver	Faban-kit	Database	SQL Server
Monitor	Vmstat	Number of concurrent session	1,2,3

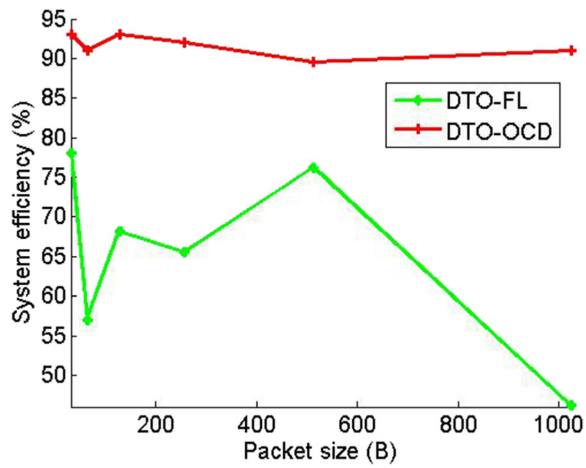

Fig. 4 System efficiency when packet error rate is 0.5%

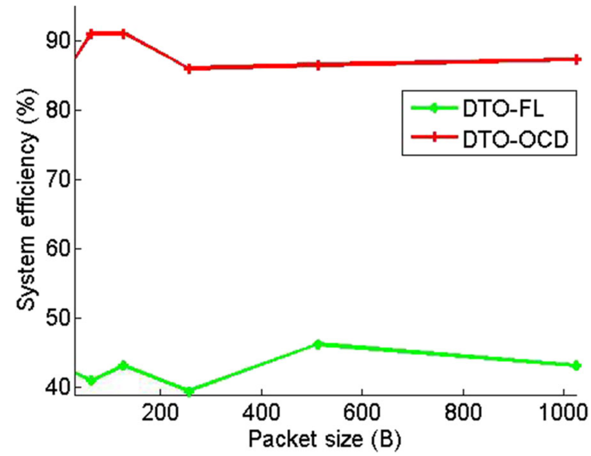

Fig. 6 System efficiency when packet error rate is 5%

The relation is used to establish the optimal crowd feedback closed-loop control system. The experimental structure is shown in Fig. 3. The server hardware and system software configuration is shown in Table 1.

In the experiments, we compared the proposed data transmission optimization-optimal crowd feedback (DTO-OCD) with the data transmission optimization strategy based on the optimized feedback loop data transmission optimization-feedback loop (DTO-FL) with the system efficiency and throughput performance. Figures 4, 5, and 6 give the DTO-OCD and DTO-FL system efficiency with the change of the data packet size when the packet loss rate is 0.5, 1, and 5%, respectively. Found that with the increase of the packet loss rate, the system efficiency of the two mechanisms began to significantly reduce. With the increase of the data packet, the system efficiency of the two mechanisms is chattering. However, the system efficiency of DTO-FL decreased more obviously. Its decline range is the same or two times as much as that of DTO-OCD. DTO-FL jitter is more efficient than that of DTO-OCD.

Figures 7, 8, and 9 give the system throughput rate results with the change of the data packet size when the wireless network mobile speed is 0.5, 1, and 5 m/s, respectively. With the increase of the speed of node movement, we found that the external disturbance is the key factor to control the quality of data transmission. The system throughput rate of the two mechanisms began to significantly shake. The jitter is especially evident when the moving speed is 5 m/s. In addition, with the increase of the data package, the system throughput declined. However, the system efficiency of DTO-FL decreased more obviously. The decline range of DTO-FL is 2 times the one of DTO-OCD.

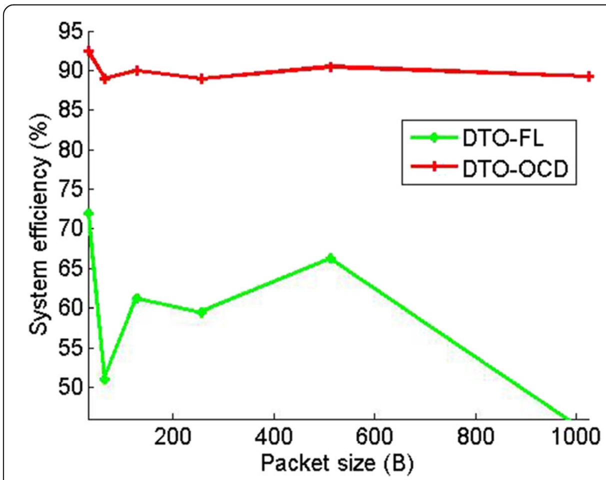

Fig. 5 System efficiency when packet error rate is 1%

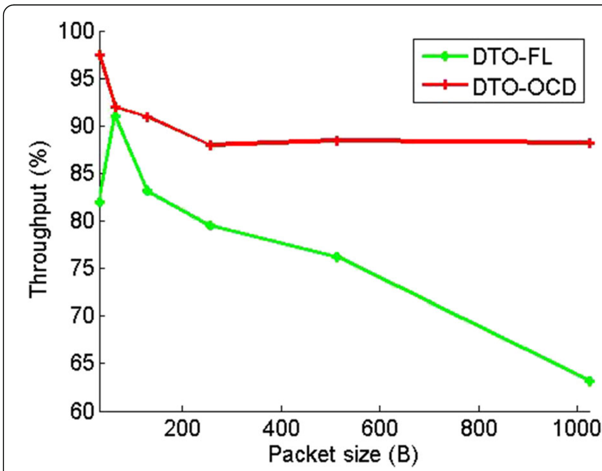

Fig. 7 Throughput when moving speed is 0.5 m/s

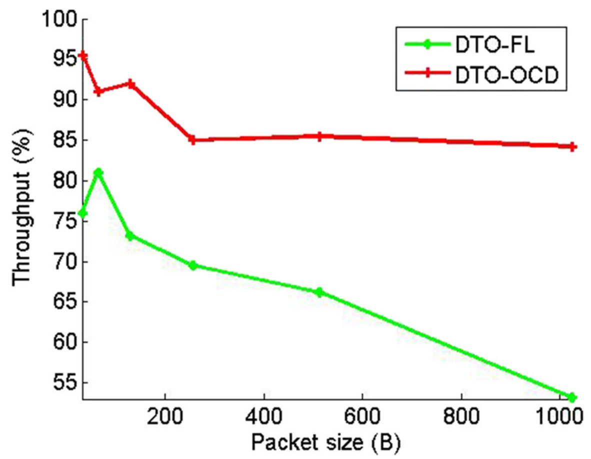

Fig. 8 Throughput when moving speed is 1 m/s

5 Conclusions

Based on the study of the decline reasons of the data transmission performance in the wireless network environment and the influencing factors of the feedback mechanism, we put forward the optimal crowd control of the wireless network data transmission. The innovation of the scheme has also a crowd feedback mechanism, data encapsulation, mobile management, and sensory feedback. Firstly, a closed-loop control system is formed between the transmitter and the receiver, which is affected by the interference of the wireless data transmission. The aim of the system is to eliminate the key factors of these factors. Secondly, according to the time domain linear weight, crowd feedback module is designed to the optimal feedback closed-loop control system. Finally, on the basis of the above researches, we proposed an adaptive optimization model of mobile data transmission. Based on the experimental results, we found that the system efficiency and the system throughput rate of the proposed algorithm are higher and the system throughput is higher and smoother.

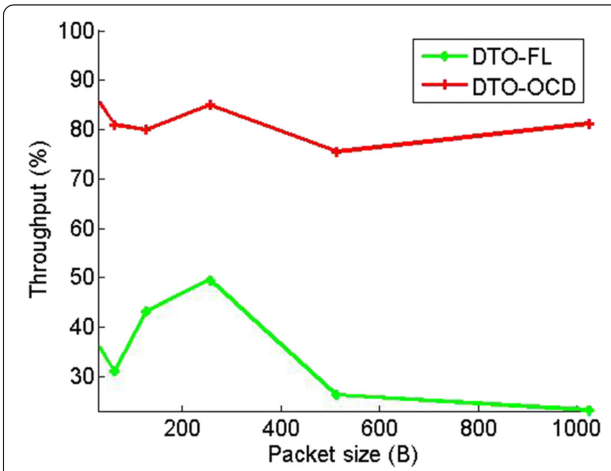

Fig. 9 Throughput when moving speed is 5 m/s

Competing interests

The author declares that he/she has no competing interests.

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