Chapter 2
Media Synchronization Control in Multimedia Communication

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ABSTRACT

In this chapter, first, we explain media synchronization control. Next, we make a survey of media synchronization control techniques and classify the techniques. Also, we compare group synchronization control schemes. Then, we propose new control called the dynamic local lag control in joint musical performance which has severe requirements on high quality of media synchronization and high interactivity. In the performance, multiple users play their respective same or different types of musical instruments together. However, the media synchronization quality and interactivity may seriously be deteriorated owing to the network delay. By Quality of Experience (QoE) assessment, we demonstrate that the new control can achieve high quality of media synchronization and keep the interactivity high. Finally, we discuss the future directions of media synchronization control.

INTRODUCTION

In this chapter, we explain the state-of-the-art work on media synchronization control in multimedia communication and discuss its future work. In our daily lives, we communicate with each other over a network for various purposes by using multiple media streams such as voice, video, haptic media, and olfactory media (Natarajan, 2003). In multimedia communication, media synchronization among the streams is very important (Blalowski & Steinmetz, 1995). However, the media synchronization may be disturbed owing to network delay, delay jitter, and packet loss. If the media synchronization quality is deteriorated, the quality of experience (QoE) (ITU-T Rec. G.100/P.10, 2007) may seriously be damaged. To solve such a problem, we need to carry out media synchronization control, which adjusts the output timings of streams at each terminal to achieve high quality of media synchronization. A number

DOI: 10.4018/978-1-4666-8850-6.ch002

of researchers have been studying media synchronization control so far (Blalowski & Steinmetz, 1995; Ehley et al., 1994; Ishibashi & Tasaka, 2000; Huang et al., 2013; Boronat et al., 2009).

A survey of media synchronization control was made, and techniques used in the algorithms for the control were classified into four categories (Ishibashi & Tasaka, 2000). However, a number of researches about media synchronization control have been done since the survey (Huang et al., 2013). Therefore, it is time to redo a survey of new media synchronization control techniques including the conventional ones as in (Ishibashi & Tasaka, 2000).

In this chapter, first, we explain media synchronization control. Next, we make a survey of media synchronization control techniques and classify the techniques. Also, we compare group synchronization control schemes. Then, we propose new control called the *Dynamic local lag control* in joint musical performance, which has severe requirements on high quality of media synchronization and high interactivity. In the performance, multiple users play their respective same or different types of musical instruments together. However, the media synchronization quality and interactivity may seriously be deteriorated owing to the network delay. By QoE assessment, we demonstrate that the new control can achieve high quality of media synchronization and keep the interactivity high. Finally, we discuss future research directions of media synchronization control.

MEDIA SYNCHRONIZATION CONTROL

Media synchronization may be disturbed owing to network delays and skews, which are caused by many reasons such as the difference of time in capturing media among terminals, the difference of time in protocol processing, media interleaving, network delay jitter, packet loss, the difference of decoding time at the playout process, and clock difference. Media synchronization control is carried out to compensate for the network delay jitter. We can identify two types of media synchronization control: *Object* (or *event-driven*) and *continuous* synchronization control (Campbell et al., 1992). Object synchronization control means synchronization control among multimedia objects. The control adjusts the beginning output timings of media according to a scenario. Under continuous synchronization control, the output timings (e.g., output times and speeds) among media streams can be synchronized with each other. In this chapter, we focus on continuous synchronization control. Media synchronization control is categorized into three types:

- *Intra-stream*
- *Inter-stream* (Blalowski & Steinmetz, 1995; Ehley et al., 1994; Ishibashi & Tasaka, 1995, 2000; Huang et al., 2013; Boronat et al., 2009, Ishibashi et al., 2003), and
- *Group* (or *inter-destination*) *synchronization control* (Ishibashi et al., 1997; Ishibashi & Tasaka, 1997, 1999).

The intra-stream synchronization control is necessary for preservation of the timing relation in a single stream. The inter-stream synchronization control is required for keeping the temporal relation among media streams. Media streams generally fall into a master stream and slave streams. Only the intra-stream synchronization control is carried out over the master stream, and the inter-stream synchronization control is exerted for the slave streams after carrying out the intra-stream synchronization control over each slave stream (Ishibashi & Tasaka, 1995). It is also possible to apply only inter-stream synchronization