Preface

This book surveys algorithms and techniques of crowd simulation, and is intended for graduate students, researchers, and professionals. In particular, computer animation researchers, developers, designers, and urban planners will greatly benefit from this book. This second edition presents new techniques and methods proposed since 2007, when we published the first edition of the book.

In 1996, when the authors started researching into crowd simulation, there was very little material available on this topic in the Computer Science literature. Daniel Thalmann supervised Soraia Raupp Musse's PhD thesis in 1997 and since then they have both extensively published in the domain. As a result, many other research groups have also started working in the area. As early pioneers in this research, the authors organized the first workshop on Crowd Simulation (V-Crowds) in 2005 in Lausanne. Today, Daniel Thalmann at the Nanyang Technological University in Singapore and Soraia Raupp Musse at PUCRS in Brazil keep working on crowds. Crowd simulation is now a popular area of research and many techniques have been developed, with the entertainment industry in particular realising the potential of crowd animation. But why is this subject so fascinating?

Aggregated motion is both beautiful and complex to contemplate. Beautiful due to the synchronisation, homogeneity and unity described in this type of motion, and complex because there are many parameters to be handled in order to provide these characteristics. History shows that there has always been interest in understanding and controlling the motion and behaviour of crowds of people. Psychologists and sociologists have studied the behaviours of groups of people for several years, primarily to study the effects that occur when people with the same goal become one entity—a crowd or a mass. When this happens, people can lose their individuality and adopt the behaviour of the crowd entity, behaving in a different way than if they were alone.

The simulation of large crowds in real time requires many instances of similar characters. We need algorithms to allow for each individual in the crowd to be unique. In this book we present some possibilities of character generation and customization. We emphasize population modelling, including shapes, sizes, and colors. We also discuss the importance of adding accessories like bags, glasses, mobile

phones, and their impact on animation. This topic is very important in the sense that it provides coherent visualization of populations, as discussed in Chap. 3.

Crowd animation is fundamentally based on the animation of the individual virtual humans. Chapter 4 explains the methods used to animate these individuals especially their locomotion. We explain walking models based on methods like Principal Component Analysis. We also insist on animation variety as it is essential for realistic crowd behaviour.

Certain problems arise only when studying crowds. For instance, crowds have a certain intelligence in collective behaviors, whilst individual intelligence and behaviors can be observed at the same time. Interaction (verbal or non-verbal) among individuals, groups and crowds can be perceived in low density flow of persons. Navigation is probably the most crucial behavior for crowds that can be simulated on a computer. We discuss in detail techniques of path planning including a new hybrid approach between navigation graphs and potential-based methods. Collision avoidance problems related to a large number of individuals in the same place require different strategies in comparison with the methods used to avoid collision between individuals. In real life people can stop because they don't have enough space to walk, and unfortunately they can even die because the high density of individuals in the same space. We also introduced a new Section on gaze attention as we think it is important that individuals seem aware of the environment and other people. The relationship between people and the environment is given by some aspects such as culture, knowledge, experience, memory, etc. Computers should generate behavior patterns to achieve such levels of interaction. Chapters 4 and 5 present some aspects to contribute with this discussion.

Moreover, a crowd is not only a large group of individuals, but can also be formed by groups which in turn are related to individuals. In addition other levels of behaviour can exist when treating crowds in this hierarchical structure. The group behaviours can be used to specify the way a group moves, behaves and acts. Individual abilities can also be required in order to improve the autonomy and intelligence of crowds, for instance perception, emotional status, memory, communication, etc. However, when we consider thousands of individuals, these complex behaviours cannot be provided individually due to the hardware constraints and to computational time rates. A further problem relates to how to improve the intelligence and provide autonomy to scalable crowds, in real-time systems. In Chap. 6 we discuss the integration of crowd simulation and computer vision to bring new ground in this discussion.

Chapter 7 discusses techniques for rendering crowds especially when real time simulations are required to populate virtual environments in virtual reality systems. We introduce a complete pipeline for fast rendering including levels of details, deformable and non-deformable characters as well as impostors. A new section explains how crowd patches can be used to generate unlimited populated environments.

Crowd simulation is dependent on the environment, which means that this environment has to be modelled in a specific way. Chapter 8 discusses how to model such informed environments including terrains and buildings. It also shows how ontologies can play an essential role in crowd simulation.

The last Chapter is dedicated to applications and case studies like crowds in Virtual heritage and Safety systems. We have added a new Section on the revival of the Pompeii city and another on immersion in crowds.

Some crowd requirements along with strategies and techniques that can be adopted to deal with these, are described in this book. Some of the topics presented are related to population modelling, virtual human animation, computer vision techniques focusing on crowd control and crowd rendering, and some applications are analysed.

Acknowledgements The authors would like to thank to Springer and Matheus Ruschel for support in the text edition.

http://www.springer.com/978-1-4471-4449-6

Crowd Simulation
Thalmann, D.; Musse, S.R.
2013, XV, 296 p., Hardcover
ISBN: 978-1-4471-4449-6