

# Chapter 1

## Co-ordinating Formations: A Comparison of Methods

**Jussi Laasonen**

*University of Turku, Finland*

**Jouni Smed**

*University of Turku, Finland*

### ABSTRACT

*Moving in a formation is a basic group behaviour needed in computer games. This chapter presents different methods for co-ordinating formations in real-time game environments. To compare the methods in different situations, how well the formations stay organized and how fast they are able to navigate through test courses is measured. Additionally, the authors analyse whether the methods can cope with pathological situations such as passing through a narrow canyon. The effect of different formation types and study the scalability when the formations get larger are also compared.*

### INTRODUCTION

Computer-controlled entities often have to move in a formation. For example, a real-time strategy game can include hundreds of computer-controlled entities on a battlefield, which are not to be controlled individually but as groups. If the entities are commanded on this higher level, the player can control even larger units with less effort. Therefore, formations can improve the visual appeal and realism of a game, because the units

seem to move in a natural looking way rather than in unorganized groups.

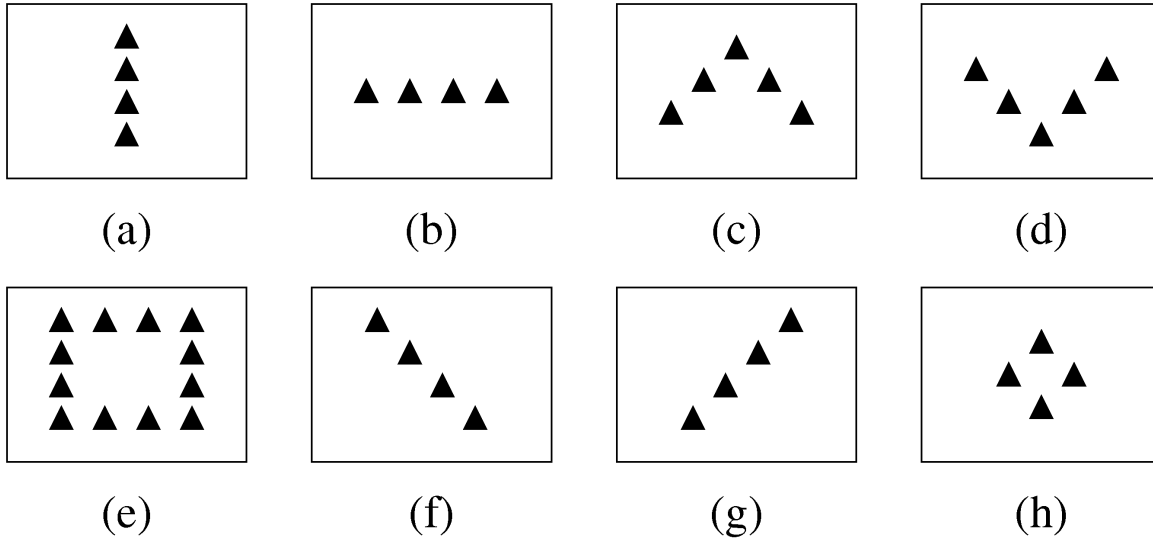
The task of co-ordinating formations can be divided into three subtasks:

1. Define a control structure for the formation.
2. Find a path for the whole formation.
3. Steer the individual entities.

Control structure is used to model the formation, and it defines how to calculate the places of the agents (or entities) in a formation (for basic formation types, see Figure 1). To realize this we

DOI: 10.4018/978-1-4666-1634-9.ch001

Figure 1. Basic formations types: (a) column, (b) line, (c) wedge, (d) vee, (e) box, (f) right flank, (g) left flank, and (h) diamond



can choose from several different control structures, which can be based on following a leader or the average position of the neighbours.

In path finding, we search for the shortest viable path from a start position to a goal position. For this subtask, the most commonly used path finding algorithm is A\*, which has many game-dependent variants to make it faster. The path found by the algorithm can look unrealistic, but it can be improved by path realization methods to make it look more natural.

When we have found a path, the agents are guided through the game world using a steering method. It tries to keep the agents as close to their intended place in the formation as possible. Moreover, it should allow the agents to deviate if the environment does not allow them to maintain a tight formation.

In general, decision-making can be divided into three levels: strategic, tactical, operative (Smed & Hakonen, 2006). Strategic level contains long-term decisions based on large amounts of data. Tactical level handles group-level decisions aiming at fulfilling a plan made at the strategic level. Operational level focuses on short-term decisions from a limited set of alternatives. In this chapter, we will focus on operational level decision-making

in the domain of co-ordinating formations. We assume that the path for the formation has already been found and we must now steer the group using a control structure. For this reason, we have implemented three different formation methods: a steering behaviour-based method, a fuzzy logic controller, and a mass-spring system. We test the performance of these methods with different metrics, measuring the level of organization of a formation and the speed at which they solve test tracks. We analyse closely pathological cases such as passing through a narrow canyon. Moreover, we compare the results for different types of formations (e.g., square, line and column) to see their effect on the methods. Finally, we present results from massive formations that can include up to 100 computer-controlled entities.

## FORMATIONS

In this section, we present methods for modelling and controlling formations. First we look at different approaches to model formations, which are classified according to how the point-of-reference

20 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/ordinating-formations-comparison-methods/66315](http://www.igi-global.com/chapter/ordinating-formations-comparison-methods/66315)

## Related Content

---

### Moving Forward by Looking Back: Using Art and Architectural History to Make and Understand Games

Christopher Totten (2016). *Contemporary Research on Intertextuality in Video Games* (pp. 162-187).

[www.irma-international.org/chapter/moving-forward-by-looking-back/157031](http://www.irma-international.org/chapter/moving-forward-by-looking-back/157031)

### Gamification for Organizational Change and Innovation

Assia Alexandrova and Lucia Rapanotti (2022). *Handbook of Research on Gamification Dynamics and User Experience Design* (pp. 51-73).

[www.irma-international.org/chapter/gamification-for-organizational-change-and-innovation/311130](http://www.irma-international.org/chapter/gamification-for-organizational-change-and-innovation/311130)

### Flow Genres: The Varieties of Video Game Experience

Ondej Hrabec and Vladimír Chrz (2015). *International Journal of Gaming and Computer-Mediated Simulations* (pp. 1-19).

[www.irma-international.org/article/flow-genres/125443](http://www.irma-international.org/article/flow-genres/125443)

### Cognitive Apprenticeship Inspired Simulations

Kay Kyeongju Seo, Aimee Byk and Chris Collins (2009). *Digital Simulations for Improving Education: Learning Through Artificial Teaching Environments* (pp. 381-393).

[www.irma-international.org/chapter/cognitive-apprenticeship-inspired-simulations/8526](http://www.irma-international.org/chapter/cognitive-apprenticeship-inspired-simulations/8526)

### Playing Aloud: Leveraging Game Commentary Culture for Playtesting

Anthony Pellicone, David Weintrop, Diane Jass Ketelhut, Ekta Shokeen, Michel Cukier, Jandelyn Dawn Plane and Firoozeh Rahimian (2022). *International Journal of Gaming and Computer-Mediated Simulations* (pp. 1-16).

[www.irma-international.org/article/playing-aloud/296705](http://www.irma-international.org/article/playing-aloud/296705)