Chapter 48

Unpredicted Trajectories of an Automated Guided Vehicle with Chaos

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ABSTRACT

Intelligent Transportation Systems (ITS) are the future of transportation. As a result of emerging standards, vehicles will soon be able to talk to one another as well as their environment. A number of applications will be made available for vehicular networks that improve the overall safety of the transportation infrastructure. This chapter develops a method to impart chaotic motions to an Automated Guided Vehicle (AGV). The chaotic AGV implies a mobile robot with a controller that ensures chaotic motions. This kind of motion is characterized by the topological transitivity and the sensitive dependence on initial conditions. Due the topological transitivity, the mobile robot is guaranteed to scan the whole connected workspace. For scanning motion, the chaotic robot neither requires a map of the workspace nor plans global motions. It only requires the measurement of the workspace boundary when it comes close to it.

INTRODUCTION

Today, robotics has become a key technology in many current industrial environments and are used in companies that require high degrees of automation. Robotics is an area that studies the link between perceptions and actions, and the robot is a device that performs tasks or activities similar to humans that are influenced by new customer requirements regarding the specific characteristics of products and services (quality, quantity and time). Important advancements have been made in the area of manipulators which are used in flexible manufacturing systems (FMS). Their use has grown significantly because they are highly efficient in performing repetitive tasks

(assembling, welding, and painting, among others). Their greatest disadvantage is displacement; they cannot physically move from one point to another within their environments because they possess limited movements to be performed in restricted spaces, which is quite different than what is expected from mobile robots. The nature of mobile robots permits them to move around a factory while avoiding obstacles, which makes them more flexible and increasingly demanded by industry.

Mobile robots are used in different environments (water, air, industrial, among others) and have been the object of development in the fields of mechanics, mechatronics, sensing, communications, navigation and movement optimization. The scope of mobile robots is not restricted to industry. It is significantly greater, reaching the areas of underwater exploration, oceanographic and planetary exploration, as well as military applications and logistics (distribution and warehousing). Currently, industrial projects conducted using mobile robotics have application mainly in manufacturing (cells and factories, flexible manufacturing systems), in the distribution chain logistics, storage and services. There are two fundamental types of systems in these fields of application: AS/RS (Automated Storage/Retrieval System) (Lowe, 2002) and AGVs (Automated Guided Vehicles) (Lengerke, et al., 2008). In recent years, there has been interest in developing technologies applied in AGVs, including the automation of tasks related to transportation, loading and unloading of materials or simple inspection tasks, which implies monitoring and controlling vehicle movements from a starting point to an endpoint, thus offering significant risk reduction, offset times and energy consumption. AGV systems are considered as one of the most appropriate methods to support the handling of materials in automated production environments. In general, AGV systems consists of a set of vehicles without drivers who operate cooperatively, carrying goods and materials between different workstations and storage locations, thus facilitating production. These vehicles usually follow a predetermined physical or virtual path that is incorporated in the layout of the manufacturing site and coordinated by a system of control which is based on centralized or distributed computers.

The movement of vehicles is based on the study of the various navigational techniques that use different types of sensors (infrared, ultrasonic, vision, optical, magnetic, etc.) or paths guided by wires as part of the equipment of the mobile robot.

Some of the advantages of this type of system are: increased flexibility of the forwarding of vehicles in the layout, improved use of space and security, as well as reduced operation costs (Reveliotis, 2000). The use of these vehicles has grown enormously since their introduction in 1973 in the Volvo vehicle production plant in Kalmar. The number of application areas and variation in types has increased significantly as warehouses and factories have increasing numbers of intersections and factory layouts, in general, become more complex with greater internal and external transport of material and handling of parts and products between workstations. Currently there are several applications used for repetitive tasks, such as transport manufacturing operations that work with average production volumes, including flexible manufacturing systems, storage and service industries. Also, these systems are used for various tasks such as mail sorting, luggage transport at airports, container cargo transport and tracking (Steenken et al., 2005), security, and even in hospitals (Ceric, 1990, Krishnamurthy & Evans, 1992).

Science has advanced a long way in making humans increasingly understand nature, enabling them to predict phenomena that occur in the near future, or reconstruct the past with the present information. However, the use of knowledge and of natural laws to forecast new phenomena and also to retrieve past events is not an easy one. What is the sense of humankind spoiling the environment in such a way that Mother Nature reactions are becoming so overwhelming?

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