INSTITUTE OF PHYSICS PUBLISHING SMART MATERIALS AND STRUCTURES

Smart Mater. Struct. **11** (2002) 169–17 PII: S0964-1726(02)30163-0

TECHNICAL NOTE

Smart collision information processing sensors for fast moving objects

A Akgunduz[1], P Banerjee[1,3] and S Mehrotra[2]

[1] Department of Mechanical Engineering (M/C 251), 3029 Engineering Research Facility, 842 W Taylor, University of Illinois, Chicago IL 60607-7022, USA
[2] Department of Industrial Engineering and Management Sciences, Northwestern University Evanston, Illinois, USA

E-mail: banerjee@uic.edu

Received 3 May 2001, in final form 5 October 2001
Published 6 February 2002
Online at stacks.iop.org/SMS/11/N169

Abstract
In this technical note we survey the area of smart collision information processing sensors. We review the existing technologies to detect collision or overlap between fast moving physical objects or objects in virtual environments, physical environments or a combination of physical and virtual objects. We report developments in the collision detection of fast moving objects at discrete time steps such as two consecutive time frames, as well as continuous time intervals such as in an interframe collision detection system. Our discussion of computational techniques in this paper is limited to convex objects. Techniques exist however to efficiently decompose non-convex objects into convex objects. We also discuss the tracking technologies for objects from the standpoint of collision detection or avoidance.

(Some figures in this article are in colour only in the electronic version)

Introduction

Smart sensors are not transducers or signal processing elements. They are information sensors. Smart sensors are those devices that integrate sensors and circuits to process information obtained from environments without a significant human interference [17]. The areas of application vary from automotive exhaust sensors to intelligent automobile collision avoidance sensors. With improved technology, sensors have become smaller in size and processors have become more and more powerful, and the area of application of smart sensors continues to widen. In this technical note, some of the areas of application of smart collision-sensing systems are surveyed. The area is extremely huge and hence only a fraction of the possible realm of applications is considered, to provide the readers with an overall exposure to the issues.

Sensing the collision between moving objects is one of the challenging tasks in computational geometry. For example, determining a possible collision between two airplanes in advance can not only continue to save many lives, but can also allow us to operate more efficiently by removing some of the ultra conservative restrictions imposed as a result of inadequate trust in the system. Under poor visibility conditions, ground collision avoidance systems can increase the terminal area productivity in airports. Use of virtual reality technology in military training is not new. Efficient collision detection tools trace the route of fast moving objects such as bullets, rockets, fighting jets, etc and increase the realism of these simulations. A smart system that controls the traffic flow and helps drivers to make decisions to avoid collisions with other automobiles on the highway can increase highway safety, and reduce the delays caused by accidents. In high speed machining, contact between machining tools and the work-piece is critical. Sensing the possible collisions as well as depth of contact between the part and the machine in advance and taking required actions to avoid unnecessary collisions

[3] Author to whom correspondence should be addressed.