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GENETIC FUZZY-BASED STEERING WHEEL CONTROLLER USING A MASS-PRODUCED CAR

E. Onieva, V. Milanés, J. Pérez and T. de Pedro

AUTOPIA Program at the Robotics and Automation Center (UPM-CSIC)
La Poveda-Arganda del Rey, Madrid 28500, Spain
{ enrique.onieva; vicente.milanes; joshue.perez; teresa.pedro }@car.upm-csic.es

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Abstract. *Intelligent Transportation Systems (ITS) cover a broad range of methods and technologies that provide answers to many problems of transportation. Unmanned control of the steering wheel is one of the most important challenges facing researchers in this area. This paper presents a method to adjust automatically a fuzzy controller to manage the steering wheel of a mass-produced vehicle to reproduce the steering of a human driver. To this end, information is recorded about the car's state while being driven by human drivers and used to obtain, via genetic algorithms, appropriate fuzzy controllers that can drive the car in the way that humans do. These controllers have satisfy two main objectives: to reproduce the human behavior, and to provide smooth actions to ensure comfortable driving. Finally, the results of automated driving on a test circuit are presented, showing both good route tracking (similar to the performance obtained by persons in the same task) and smooth driving.*
Keywords: Autonomous vehicles, Genetic algorithms, Fuzzy control, Fuzzy logic, Intelligent vehicles, Intelligent transportation systems (ITS), Lateral control

1. **Introduction.** Autonomous vehicle control is an open field of research in the area of Intelligent Transportation Systems (ITS). ITS apply information and communication techniques so as to achieve both safer and more efficient driving. In this sense, automotive manufacturers have introduced Advanced Driver Assistance Systems (ADAS) in their commercial car as an attempt to prevent collisions and minimize injuries [1]. These systems are based on different sensors capable of receiving the information coming from vehicle's surroundings. This information is used to warn the driver in case of unexpected traffic circumstances. The next step is to provide the vehicle with autonomous systems capable of not only warning the driver but also acting so as avoiding traffic accidents.

Different research groups have faced ITS problems worldwide, like California PATH (Partners for Advanced Transit and Highways) [2, 3], VaMoRs-P [4], VITA (VIsion Technology Application) [5], Ohio State University [6] and Carnegie Mellon University [7] in the United States; PROMETHEUS (Program for a European Traffic with Highest Efficiency and Unprecedented Safety) [8], the ARGO vehicle [9] and CyberCars project [10] in Europe; and several research programs under ITS Japan [11, 12].

AUTOPIA program at Center of Automation of Robotics (CAR) of the Spanish National Research Council (CSIC) has been working in autonomous vehicles during last 15 years. A fully-autonomous vehicle is based on managing vehicle's actuators – i.e., steering wheel and brake and throttle pedals. To this end, vehicles are equipped with the instrumentation and software necessary to perform driving-related tasks autonomously. In recent work [13], longitudinal control – i.e., brake and throttle pedals – was automated