

ABSTRACT

Traffic acoustical noise is one of the most important component of the urban environmental pollution in densely populated areas all over the world.

A very recent ACI-Censis study [1] on Italian urban areas shows that car is the favorite mean of transportation for 90% of population. In particular, this study shows that during years ranging from 2000 to 2007, the number of circulating vehicles is grown of 14.5%. To this growth did not always correspond an improvement of national street network. This problem can be evidenced by the high growth of the traffic charge on urban, sub-urban and extra-urban roads, with a clear impact on costs, security and environment, even in term of acoustical noise. A similar tendency can be observed in the framework of many european countries. Traffic noise affects areas surrounding roads especially when high traffic load and high speed conditions occur and can lead to a degradation of the quality of life in residential areas. The impact of noise on mental and physical health and on daily activities has been widely documented in the scientific literature [2, 3, 4]. In particular a continuous exposure to acoustical noise may affect sleep and/or conversation, may lead to perception of annoyance, may cause hearing loss, cardiovascular problems etc. As a consequence, during last years, a large number of anti-noise laws, ordinances and regulations were decreed by many national governments and international institutions. Looking to Italy, it is the D.P.C.M. 01.03.1991 [5] which regulates noise pollution matters, giving the main acoustical elements definitions such as maximum limit of noise exposure in inner and external environment, acoustic zoning criteria, etc. Then the Framework Law n. 447/1995 has defined a general policy on the noise pollution that has been implemented in different decrees and regulations.

Among these, one of the most interesting is the D.M.A. 16.03.1998 "Noise pollution detection and measurement method" (Tecniche di rilevamento e di misurazione dell'inquinamento acustico) which deals with the vehicular and railway noise detection procedure. Moreover the D.Lgs 194/2005 (Attuazione della direttiva 2002/49/CE relativa alla determinazione e alla gestione del rumore ambientale) establishes the method to set the acoustic indicator for the different kind of noise sources such as vehicular traffic.

In this Ph.D. thesis our aim is to improve the current prediction tools for traffic noise prediction in non trivial situations such as traffic lights, traffic jam, intersections etc., accounting some aspects of traffic dynamics by the use of traffic models (TM), i.e. following the leader model and Cellular Automata.

This thesis is organized as follows. In the first chapter we briefly discuss the main features of sound and noise propagation. In the second chapter we focus our attention on vehicle noise emission and existing traffic noise models (TNM) while in the third we present a new noise prediction procedure: GERIAN2009. In chapter four some general features of physics of road traffic and transportation are discussed. In the last three chapters we propose an integration of traffic noise model and traffic dynamic model in the "following the leader" and Cellular Automata (CA) framework, with a particular attention on road's intersection issue.