Chapter 80

Determination of Work Zone Capacity Using ELM, MPMR and GPR

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ABSTRACT

This article examines the capability of Extreme Learning Machine (ELM), Minimax Probability Machine Regression (MPMR) and Gaussian Process Regression (GPR) for determination of Work Zone Capacity. Number of lanes, number of open lanes, work zone layout, length, lane width, percentage trucks, grade, speed, work intensity, darkness factor, and proximity of ramps have been adopted as inputs of ELM, MPMR and GPR. ELM has excellent generalization performance, rapid training speed and little human intervention. MPMR is developed based on the concept of minimax probability machine classification. It does not assume any data distribution. GPR is a probabilistic, and non-parametric model. In GPR, different kinds of prior knowledge can be applied. This article describes a comparative study between the ELM, MPMR and GPR models.

INTRODUCTION

In the past 40 years there has been a rise in traffic which has by far outdone the economic growth and shows no signs of retarding its growth rate. This disproportionate growth in traffic is leading to a voracious consumption of our resources and rapid degradation of environment. Sustainable mobility is the need of the hour. Some of the major reasons for this unprecedented growth of traffic are underlined in the following points.

1. **Urban Sprawl:** It can be defined as the unplanned expansion of human population from central urban areas into previously remote and city outskirts. This is mainly done to facilitate the influx from rural areas. This gives rise to certain land use patterns such as single use zoning (i.e. situation such that commercial, residential, institutional and industrial are separated causing extensive use of automobiles), low density zoning, job sprawl, spatial mismatch. All these together have a major impact on increasing rates of traffic growth
2. **Economic Growth:** With the rise of world economy the middle class is seeing unprecedented rise in income as well as easier access to personal automobiles due to decline in interest rates of banks. This has led to lesser use of public transport increasing road traffic.
3. **Trade and Commerce:** In the recent past there has been tremendous growth in trade integration and global trade has increased at roughly three times the rate of global aggregate output. Increased trade gives rise to increased freight traffic resulting in more numbers of heavy trucks, lorries etc.

Increase in population is a key factor in the rise of traffic levels. Population increase is mainly due to two reasons natural increase and migration. Migration is the long term settlement in certain areas after dislocation from some other. Migration is basically from rural to urban areas. This is mostly due to better socio economic condition of cities, better job opportunities, better education facilities, better health conditions and sanitation. Cities also provide a wider array of trade opportunities. This huge influx causes urban sprawl and various other problems which give rise to higher traffic rates. Some of them are discussed as under.

1. Cheaper availability of labour increases the number of infrastructure project which in turn increase freight traffic.
2. Increased workforce causes rapid industrialization causing greater traffic rates of traffic growth.

Due to single use zoning the distances between various zones has increased generating longer and more number of trips. The commuter and shopping traffic has also increased which accounts for a major chunk of private traffic movements. Relocation of workplaces from urban to regional sites leads to larger distances to commute.

Transportation distances have increased considerably in recent past signalling an increase in freight volumes as well as traffic. Economic slowdowns did have a negative impact on freight traffic but the overall trend has been of growth.

Some other reasons for increased traffic growth are enlisted as under:

1. Speculation about future government policies sometimes causes premature growth of certain regions which in turn increase traffic
2. Due to the increase in nuclear families in cities there is a larger cities wastes vertical space and result in horizontal growth causing more urban sprawl affecting traffic patterns.
3. Government policies do not allow vertical construction in places with lesser accessibility causing further urban sprawl especially in the cases of old cities.
4. Increase in transportation infrastructure such as expressways, highways etc too cause both traffic congestion as well as rapid outgrowth.
5. Increased urban economy as well as job avenues commands the need of higher transportation facilities increasing the number of vehicles plying the road.

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