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The Young European Arena of Research

Artificial Intelligence: The XXI Century Paradigm for Asphalt Pavement Modelling and Design

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Some people believe that artificial intelligence allow computers to solve complex problems with almost no efforts. If they are thinking about asphalt pavement modelling and service life prediction, yes, they are right!

For that to become a reality is very easy; it's just necessary provide the computers with the necessary data, organized in a hierarchical way, train a neural network system and, *voilà*, the "artificial brain" is able to do predictions about the pavement service life.

The first step is to create an ultra-big database with the life history of the pavement. For that, it's necessary instrument an open-to-traffic highway section with sensors and register, vehicle-by-vehicle, all variables with influence in the asphalt pavement durability, including environment, vehicles and the structural response. Every time a vehicle crosses the section, all sensors are read and the data, recorded (Figure 1).

Then, the database needs to be "translated" into another language, the math language, with one vehicle per line, in order to allow the next-step, adjust every variable according its individual relative importance as a way to give the relative importance ("pavement damage") for every line. For that, a number of tools are available in the range of soft computing and equation systems. The result will be a matrix of performance, a source of "intelligence" to train the neural network (Figure 2).

Trained, the neural network will be able make predictions about the service life for asphalt pavements (Figure 3). The problems proposed to the neural network system need to be described in the exact same way was described the initial database, with data about the environment, vehicles and structural response (Figure 4). For the design of new pavements, the structural response can be simulated with finite elements software; for use in a pavement management system, the structural response can be found with a combination of *in situ* non-destructive tests (Benkelman beam, FWD, etc.) and finite elements modelling. The prediction made by the neural network will be valid for pavements using the same materials used in the instrumented section source for the initial database.

The Figure 5 shows a comparison between this proposed "futuristic approach" against the current equation of fatigue. In the future, all pavements will be managed and designed with tools using artificial intelligence.

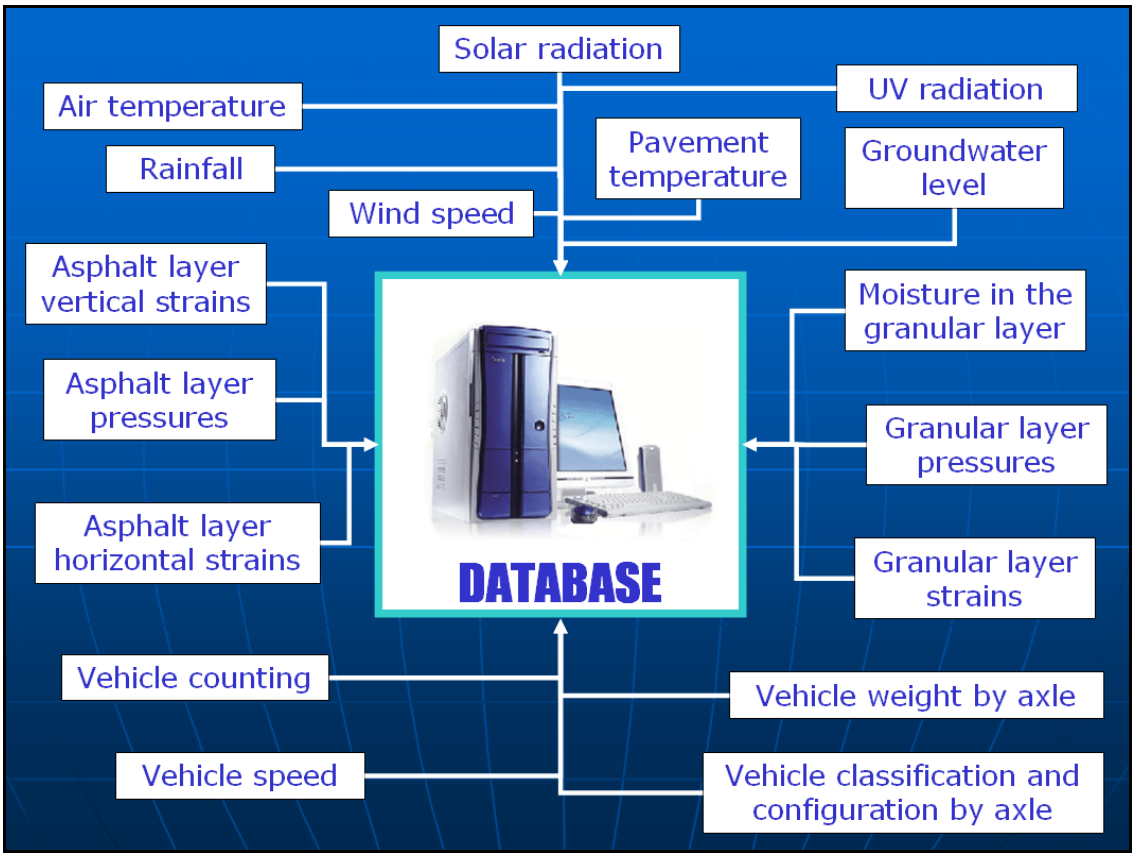

Figure 1 – Necessary variables for a database suitable for asphalt pavement modelling using artificial intelligence

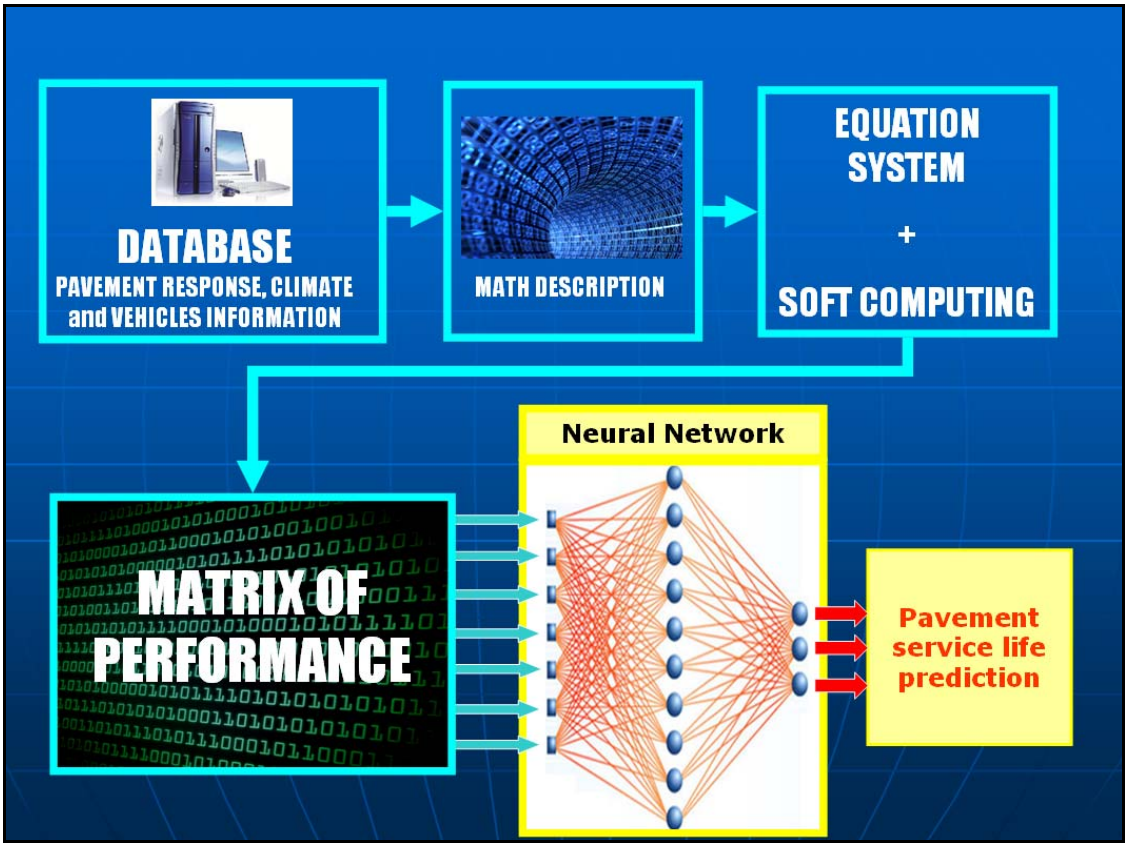

Figure 2 – The database with the history of the pavement is "handled" to become a matrix of performance to train the neural network system

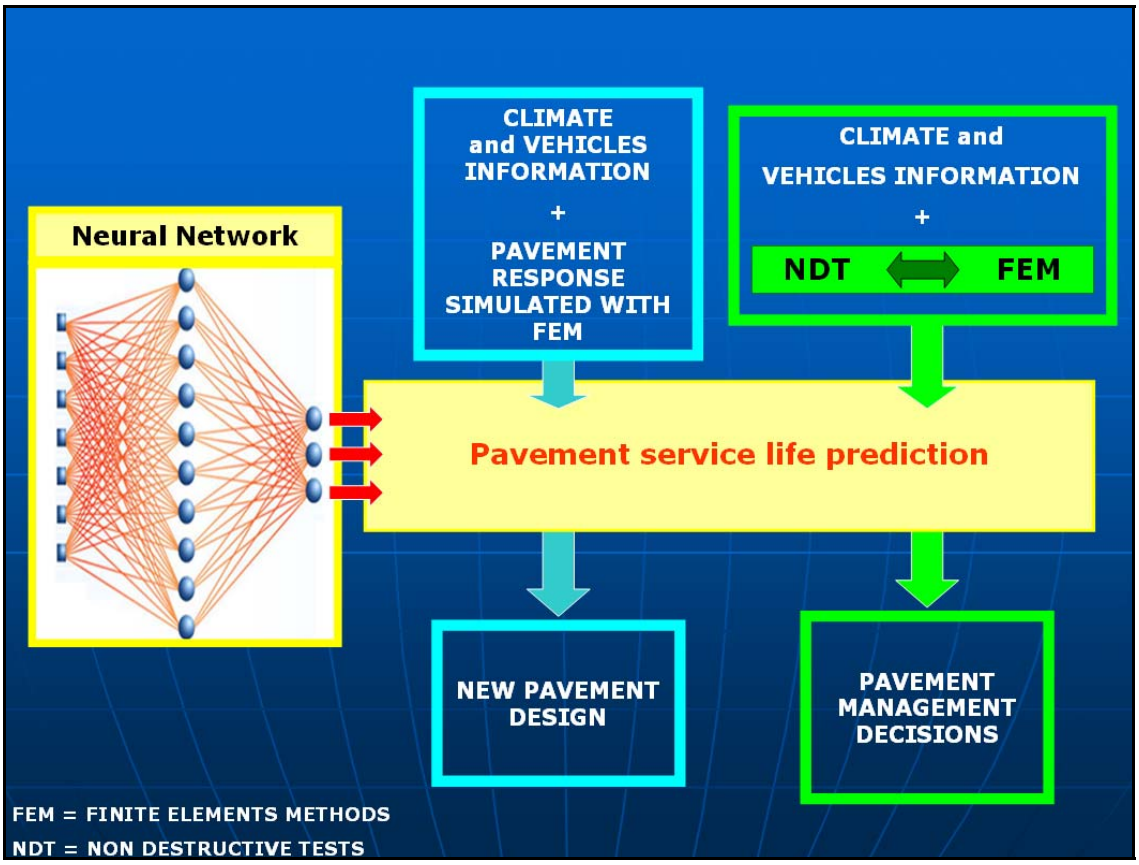

Figure 3 – The trained neural network system will do predictions about the service life for both, design new pavements and make decisions in a pavement management system

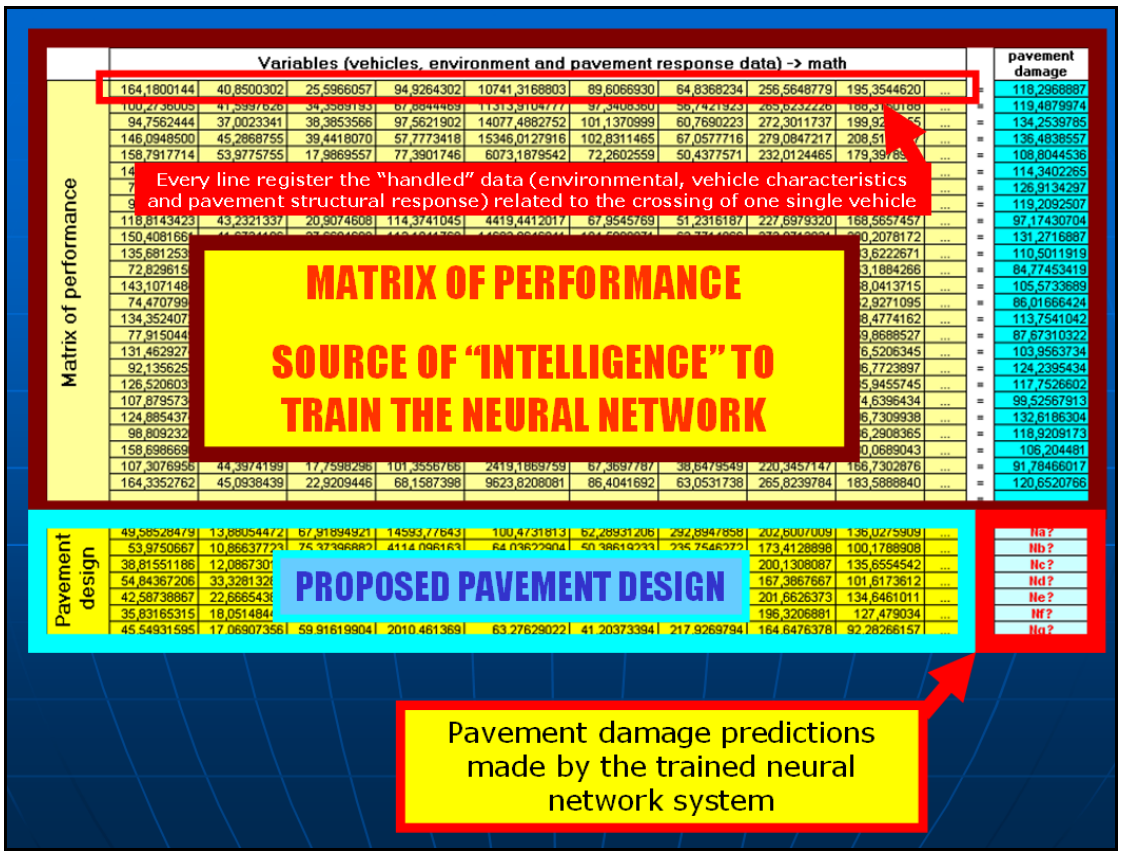

Figure 4 – The neural network will be able to make predictions for problems proposed in the exact same way was described the initial database used to generated the matrix of performance

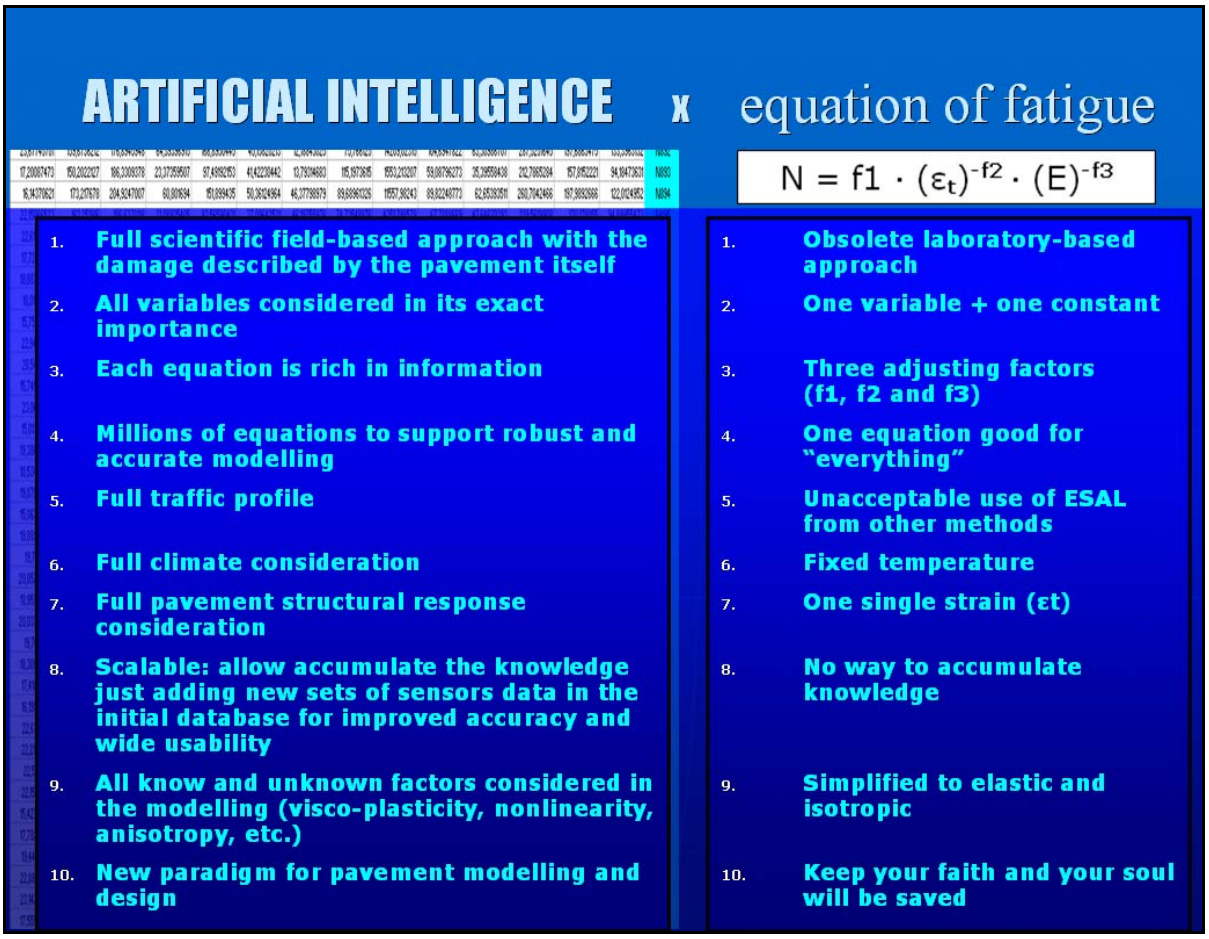

Figure 5 – Comparison between the modelling using neural network trained with the matrix of performance against the current "technology" of the equation of fatigue