Editor

Tomas Zelinka

Transport Telematics - Systemic View

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Preface

Intelligent transport systems (ITS) link information technologies with transport engineering. The ITS objective is to achieve principal transport, travel and forwarding processes services improvement within the existing transport infrastructure. ITS services cover requirements from an individual local case up to the complex wide area solutions with wide scale of services complexity. The telematics services are an integral part of the ITS. They do not represent the only telecommunications solutions, but they are tightly connected with a wide variety of transportation services. “Intelligent” services with the ability to support the relevant environment of the complex system structures are provided. Consequently, this discipline is closely linked with managerial and legal topics due to their ability to principally influence the system behavior.

There are numerous books and publication proceedings on the topic of ITS or transport telematics available but their approach and scope is different from ours. Typically, they describe the impact of ITS systems on traffic management e.g. real-time traffic management, planning of commercial vehicle operations, environmental management, etc. or they present parts of ITS solutions in big detail: e.g. electronic fare management, car navigation systems, fleet management, digital maps, strategies to reduce transport congestions, etc. In this book we introduce a very new system-oriented approach to the ITS design, operation and evaluation with respect to all predefined performance indicators like reliability, safety, security, integrity, etc.

Systems Theory represents a significant theoretical background for any professional undertaking within the branch of ITS. There are several approaches to elaborating this kind of theory, however, for engineering purposes such as the ITS the classical approach called General Theory of Systems (GTS) is usually accepted as the most beneficial. The Systems science within its application areas means resolving tasks. Efficient handling of the systems ideas implies functional knowledge of a wide range of specific mathematical tools.

The ITS applications require wireless seamless secure communications solutions with selectable level of services quality and mostly also with a wide-area coverage. Even though publically available wireless services usually provide reasonable coverage under acceptable cost conditions, most of the public providers do not offer any data service with the guaranteed quality. The principal improvement of the service quality can be reached by the selection of the best possible alternatives from the set of currently identified available services. Efficient decision processes must be adopted to reach the relevant service quality guarantee. Success of such approach relies on profound understanding of applied technologies and their performance described by the performance indicators.

Critical system properties are represented by security aspects. The difference between security and safety must be well understood. Safety assures that a life-critical system behaves as needed even when certain elements fail. Security is a condition that results from the establishment and maintenance of protective measures that ensure a state of inviolability from hostile acts or influences. Due to the fact that the human being has been a part of a system, security must be understood as a complex of measures leading to the survival of human beings in the system under the influence of an external hostile environment or any other influences. Analysis of potential threats and other security vulnerabilities specific for the telematic system represents the rest of this area. The behavior of a system consists of interactions among elements and it is to be assumed that these interactions have to be undisturbed, i.e. to be secure.

The ITS solutions resolve interactions between systems of a dissimilar nature. The differences can be in its nature, the types of these systems or in the role a particular human subject plays in such aninteraction. The functional reliability has to be considered as an important factor specifying the practical applicability of any real system. The ITS system requires to be designed with high functional reliability. The original approach is based on understanding that reliable systems have to be constructed from adequately reliable parts. Such approach can, however, lead to unrealistic and extremely expensive solutions. Besides the usage of solely reliable components the method of lifetime minimization of system functional sensitivity to system parameter changes has been applied. The newest approach developed and used only quite recently has been based on the concept of the socalled prediction diagnostics.

This book addresses scientists, R&D specialists and transport systems designers, as well as students. While the articles were written by experts that are actively involved in the discussed areas research, our intention was to present the texts at a level suitable for a general science and R&D audience. Each article contains a list of references as a point of entry to the comprehensive resources. The preparation of this publication involved generous support from an extended specialist team and we would like to express our sincere thanks to each one of our colleagues.

The Authors

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The Authors

About Authors

Miroslav SVÍTEK

Czech Technical University in Prague, Faculty of Transportations Sciences

Chapter:

- Advanced Design of Intelligent transport systems

Professor Miroslav Svítek was born in Rakovník, Czech Republic, in 1969. He graduated in radioelectronic from Czech Technical University in Prague, in 1992. In 1996, he received the Ph.D. degree in radioelectronic at Faculty of Electrical Engineering, Czech Technical University in Prague. Since 2002, he has been associated professor in engineering informatics at Faculty of Transportation Sciences, Czech Technical University in Prague. Since 2005, he has been nominated as the extraordinary professor in applied informatics at Faculty of Natural Sciences, University of Matej Bel in Banska Bystrica, Slovak Republic. Since 2008, he has been full professor in engineering informatics at Faculty of Transportation Sciences, Czech Technical University in Prague and Honorary professor at Universidad Autonoma de Bucaramanga in Colombia. He is currently teaching courses and doing research in theoretical telematics, intelligent transport systems, quantum system theory and quantum informatics. Miroslav Svítek is president of Association of transport telematics of the Czech and Slovak Republic (it covers more than 70 public and private organization), Dean of Faculty of Transportation Sciences and Head of Department of Control Engineering and Telematics, Czech Technical University in Prague. He is author or co-author of more than 200 scientific papers and 6 monographs.

Zdeněk VOTRUBA

Czech Technical University in Prague, Faculty of Transportations Sciences

Chapter:

- Systems Theory applied in Intelligent Transport Systems

Proessor Zdeněk Votruba born in Prague, April 22, 1942.
Graduated at the Faculty of Electrical Engineering of the Czech Technical University in Prague in 1964.
Carried out his postgraduate studies in Computer Research Institute, Prague (VÚMS) and at the Faculty of Mathematics and Physics of the Charles University, Prague, respectively; PhD degree in Applied Physics received in 1975.
In the seventies studied postgraduate course of applied mathematics at CTU in Prague and seminar on informatics and computer architectures at VÚMS.
In the period of 1966-1993 worked with VÚMS as a researcher (1966-1976), scientist (1976-1983), director of technological dept. (1983-1990) and technical director respectively (1990-1993). Interested in measurement and instrumentation technologies, computer peripherals, HMI, in the research of thin magnetic films and Computer Systems. Involved in managing of the complex technological projects (e.g. bipolar gate arrays, testers).
In 1990-1993 participated in the transformation of an "eastern-style". Research Institute into the group of market-oriented private companies.
In one of them, VUMS-EPOS was active in 1994-5 in the post of managing director. Involved in consultancy services, both for domestic (state administration) and international bodies.

- In 1996 joined Czech Technical University in Prague, Faculty of Transportation Sciences.
- In 2000 gained the scientific – pedagogical degree of Associate Professor in the scientific branch "Engineering Informatics".
- In the period of 2000-2008 he was in the posts of the head of Dept. of Control and Telematics and vice - dean of Faculty.
- Since 2005 full professor of Engineering Informatics in Transportation and Telecommunication; Czech Technical University in Prague, Faculty of Transportation Sci.
- Reads Lectures in Systems Science and Electronics.
- Carries - out research in the fields of Systems Science, HMI, Telematics and Reliability.

Further activities:
In seventies: teaching in postgraduate courses at CTU in Prague, Faculty of Electrical Engineering,
1980-1990: Seminars, consultancy and research at the Charles University, Faculty of Mathematics and Physics.

Awards:
Gold and Silver Felber′s Medals of CTU in Prague; Perner′s Medal of Jan Perner University in Pardubice
Membership in professional communities / bodies:
- Union of Czech and Slovak Mathematicians and Physicists
- IEEE (USA)
- Scientific Council of the Faculty of Transportation Sciences
- Grant Agency of the Czech Republic
- Evaluating Committee of the Ministry of Transport, Czech Republic
- Branch Council of Engineering Informatics CTU in Prague, Faculty of Transportation Sciences.
- Cybernetic Society of the Czech Republic

Tomas ZELINKA.

Czech Technical University in Prague, Faculty of Transportations Sciences

Chapter:
- Preface
- Telecommunications systems for ITS solutions

Professor Tomas Zelinka - Informatics - CTU in Prague, Ph.D. (CSc.) - experimental physics in the Czechoslovak Academy of Sciences, mgr. (Ing.) - Cybernetics and computer sciences at the Czech Technical University Praha, FEL

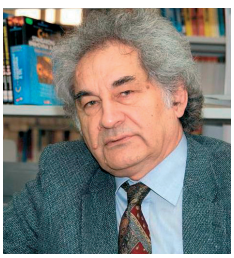
2005 – Czech Technical University in Prague, Faculty of Transportations Sciences
- Lectures: basic and advances lectures in area of the telecommunications sciences, legal issues of telecommunications, new trends in telecommunications applied in the Intelligent Transport Systems (ITS),
- R&D: theoretical background of specific telecommunications solutions dedicated for the ITS, vehicles Electronic Fee Collection (EFC) and related Value Added Services (VAS), On Board Units architecture, system security etc.

1993 – 2005 Communications business
- Development of the new products, the business development e.g. in area of alternative global voice and data communications in the Czech Republic and the other countries of the CEEMEA region
- EuroTel/Nextel/Global One (Sprint Int., France Telecom, Deutsche Telekom)
- External lecturer and mentor at the FTS of the CTU in Prague

1976 – 1993 Geophysical Institute of the Czechoslovak Academy of Sciences
- Experimental laboratory and observatory methods in geophysics, studies of the variations and drift of the Earth magnetic field, data communication solutions within international and national observatory system,
- Computer modeling of the magnetic material structures with on-line experimental identification, laboratory study of the magnetic properties of rocks,

1972 – 1976 Industrial R&D
- Automatic control systems for the technological processes – CNC,

Data communications and computer based control in technological processes.



Václav JIROVSKÝ

Czech Technical University in Prague, Faculty of Transportations Sciences

Chapter:
- Telematics System Security

Professor Václav Jirovský had graduated at Czech Technical University, Prague (CTU), Czech Republic, in radioeletronics. In his Ph.D. thesis he introduced application of theory of homogeneous structures in different areas of electronic and especially in the computer modeling. Lately he joined the Regional University Computing Center where he led department of Research and Development. His team had developed a new system for the city transport monitoring and control for Prague City Transport Corporation (PCT), based on combination of radio navigation and microwave communication. For short time he had entered the position of Executive Director for Development in the PCT, but after successful completion of the project he went back to

academia taking senior scientist position at Department of Software Engineering at Faculty of Mathematics and Physics, Charles University, Prague. In 1991 he had received position in Research and Development department of Advanced Computer Applications, Inc. in Newtown, Pennsylvania, U.S:A. finally becoming a director for R&D in the company. He left the company at 1998 joining his original team at Charles University. During years 2001/2002 he accepted position of Executive Director for Technology at Czech Telecom Corporation, lately returning back to Charles University as Associated Professor of Computer Sciences. In the year 2008 he changed position to the Czech Technical University, Faculty of Transportation Sciences, taking chair of Department of Security Technologies and Engineering. In 2007, as a member of Expert Group of the Minister of Transportation of the Czech Republic, he designed a new concept of hybrid system for electronic tolling services. His design of hybrid toll system anticipate ISO/CEN standard for European Electronic Tolling Service and had been evaluated by standardization group as the nearest implementation of EETS.

Mirko NOVÁK

Czech Technical University in Prague, Faculty of Transportations Sciences

Chapter:

- Prediction diagnostics for system reliability

Professor Mirko Novak was born on September 29, 1930 in Prague, Czechoslovakia.

In 1956 he joined the Institute of Radioengineering and Electronics of the Czechoslovak Academy of Sciences in Prague, where was the head of the Department of System Theory.

In 1965 and 1966 he has been the visiting professor of the Department of Electrical Engineering of New York University.

- In 1975 he has founded a new Institute of Computer Science of the Czechoslovak Academy of Sciences. He has been in the position of the director of this Institute for almost 15 years. Since 1965 he is the senior member of the Institute of Electrical and Electronic Engineers, Inc. and in 1988 he becomes the Corresponding member of the Czechoslovak Academy of Sciences.
- His present research interest in the field of neural networks is mainly in the theory of sensitivity and tolerances of neural networks and of their applications for signal processing, time series prediction and system reliability improvement. He is also interested in internal information systems of living bodies and of cells and in the field of the human subject – artificial, namely transportation system interaction reliability. Prof. Dr. Mirko Novák has written more than 150 research reports, about 110 scientific papers, has presented about 200 contributions on scientific conferences, colloquia and seminars and has published almost 30 scientific books in Czech, English and Russian, total - about 500 scientific presentations.

At the end of 1994 he was one of the founders of the Joint Laboratory of System Reliability between the Czech Technical University, Prague, Faculty of Transportation Sciences and the Institute of Computer Science of the Academy of Sciences, Czech Republic.
In 1999 he joined the activity of the workgroup for Neuroinformatics of the Global Science Forum OECD and took part in the preparing of the world research program in neuroinformatics. Since 2000 he is the full professor at the CTU, Faculty of Transportation sciences. He was to 2010 the chairman of the Czech National Node for Neuroinformatics and the Czech representative in INCF (International Neuroinformatic Coordination Facility) of GSF OECD.

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