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2015 Annals of Mirce-mechanics

"The goal of a scientist is to uncover new ideas, concepts and tools, practical or theoretical, that extend our understanding of the world around us and enable us to do new things. One must believe in what one is doing and stay the course. Now of course, in science one can ultimately prove the correctness of one's work by appeal to experiment and established theory. But even with this buttressing of one's ideas, acceptance can be a long and difficult road."

Richard F.W. Bader (1931 – 2012)
Grand Fellow of the MIRCE Akademy

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Mirce-mechanics

According to Einstein ***"**Everything that the human race has done and thought is concerned with the satisfaction of felt needs*".

During the history of civilisation needs for transporting, communicating, navigating and many others have been satisfied by transpiration, communication, navigation and other human created systems. The mechanics of the functioning of maintainable systems are well-understood processes, which are predictable by the laws of natural sciences, such as: Newton's laws of motion, Coulomb's law of solid friction, Hook's law of stress and strain, Maxwell's law of electrodynamics, Boltzmann's law of thermodynamics, to name a few.

Needs satisfying systems are constructed by assembling a well-defined number of parts in a precise and preestablished way. As they are functioning in predetermined linear chains of cause and effect, their performance measured through speed, acceleration, power, range, energy usage, capacity and similar is also predictable. The reason for the predictability of the system design-in functionality performance is the fact that they are based on the physical and chemical processes that are characterised by certainty, continuity, reversibility, separability and independence of time, location and humans.

Regarding the long-term satisfaction of human needs, the ability of a system to function beyond the delivery day is an essential property of its in-service performance. Due to complex interactions between consisting parts and impacts from environment and humans, disturbances of mechanical, electrical, chemical, thermal, radiant and other types are created, some of which cause occurrence of events that prevent systems from functioning. Thus, to provide the flow of functionality through time maintenance tasks like servicing, repairs, overhauls, replacements and similar are undertaken by humans, making them maintainable systems. Thus, from the point of view of the ability to function during the in-service life, known as f**unctionability**[1]**,** maintainable systems could be in a positive or a negative functionability state, at any instant of time.

Experience teaches us that unlike quantitative information regarding the design-in functionality performance of a system that is available on the delivery day, the in-service functionability performance is not. Instead, years later the statistics for various functionability measures become available. The reason for this is the fact that they are emerging properties of the complex interactions between system in-service processes, which are characterised by indeterminism, discontinuity, irreversibility, inseparability, and dependence on time, location and humans.

To scientifically understand processes and mechanisms of the motion of maintainable systems through functionability states during in-service life resulting from any causes whatsoever and to develop laws and rules that enable predictions of emerging functionability trajectory to be made in 1999 Dr Knezevic established the MIRCE Akademy at Woodbury Park. Staff, Fellows, Members and students of the Akademy study in-service behaviours of maintainable systems to:

- Determine the patterns of the motion of functionability through the life of maintainable systems and to measure emerging functionability properties.
- Understand mechanisms of the motion of functionability through the life of maintainable systems, within the physical scale from 10^{-10} to 10^{10} metre,
- Define the mathematical scheme for the prediction of emerging functionability measures for a given: maintainable system in a given in-service conditions.

[1] Knezevic, J., Reliability, Maintainability and Supportability – A probabilistic Approach, Text and Software package, pp. 291, McGraw Hill, London 1993. ISBN 0-07-707691-5

A generated body of scientific knowledge constitutes Mirce-mechanics whose axioms, formulas, methods and rules enable predictions of the emerging functionability trajectory of the future transportation, communication, navigation and many other maintainable systems to be made.

Content

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Mirce-mechanics Philosophy

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Inspired by the work of scientists and equipped with the methods of their studies, the author of this paper during last 40 years focused on systematic and objective studies of the in-service life of transportation, communication, energy and similar human created and managed systems. Hence, this paper addresses the generic knowledge of the motion of functionability of operational systems through time, obtained through observational principles and quantitative reasoning under the name of Mirce-mechanics.

Mathematical Principles of Mirce-mechanics

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Abstract

Scientific principles and concepts expressed through the laws, equations and formulas are the bedrock for the prediction of the deign-in functionality performance of any engineering creation. However, there is no equivalent when the in-service functionability performance predictions have to be made. Hence, Mirce-mechanics has been created at the MIRCE Akademy to fulfil the roll. The main purpose of this paper is to present the development and application of mathematical principles of Mirce-mechanics that are the bedrock for the prediction of the functionability performance of engineering systems.

Mirce Supportability Equation

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Abstract

Scientific principles and concepts expressed through the laws, equations and formulas are the bedrock for the prediction of the design-in functionality performance of any engineering creation. However, there is no equivalent when the in-service supportability performance predictions have to be made. Hence, Mirce-mechanics has been created at the MIRCE Akademy to fulfil the roll. The main purpose of this paper is to present the development of the Mirce Supportability Equation that is the bedrock for the prediction of the supportability performance of engineering systems.

Mirce Maintainability Equation

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Abstract

Scientific principles and concepts expressed through the laws, equations and formulas are the bedrock for the prediction of the design-in functionality performance of any engineering creation. However, there is no equivalent when the in-service maintainability performance predictions have to be made. Hence, Mirce-mechanics has been created at the MIRCE Akademy to fulfil the roll. The main purpose of this paper is to present the development of the Mirce Maintainability Equation that is the bedrock for all the predictions related to the maintenance process and related maintenance policies for a given maintainable systems.

Mirce-mechanics Analysis of Forward Visibility Loss of ATR 72 Caused by the Sea Salt Accretion on Front Windscreen

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Abstract

Mirce-mechanics is a scientific theory of the motion of a system through functionability space in time, which enables evaluation of Mirce Equations. Hence, the main objective of this paper is to present the Mirce-mechanics based analysis of the scheduled passenger flight, that carried out a go-around from its first approach to Cork Airport (EICK) in stormy weather, due to a significant increase in indicated airspeed on short final. The aircraft then positioned under radar control for a second approach to the same runway, which brought it south of Cork airport, close to the coast and at times over the sea. During this time a negative functionability event took place, which was manifested as a thick layer of sea salt formed on the front windscreens, totally obscuring the Flight Crew's forward visibility. As it was not possible to acquire the necessary visual references for landing, another go-around was necessary. To try to return the aircraft into positive functionability state, the Flight Crew flew the aircraft to areas of shower activity and a small portion of the Commander's windscreen was cleared and enabled a successful landing in the third attempt.

Aircraft Ground Icing and De-icing Processes as Mechanisms of the Motion in Mirce-mechanics

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Abstract

Mirce-mechanics is a scientific theory of the motion of in-service systems through Mirce Spacetime that enables prediction of the work done by them to be made by using Mirce Equations. Practical applications of Mirce-mechanics are possible only, when the physical mechanisms that generate the motion of systems through positive and negative states of Mirce Spacetime are understood. The mechanism of ice building on an aircraft on the ground is addressed in this paper, as a cause of occurrence of a negative in-service event. It is generated under certain environmental conditions when precipitation falling onto the aircraft freezes, mainly on upper surfaces of the wing and tail, endangering the flight safety. This type of negative events is followed by de-icing the aircraft at the airport, as a physical mechanism that causes the transition of an aircraft from the negative to the positive in-service state. Several de-icing methods are presented in this paper and their impact on aircraft and environment analysed from Mirce-mechanics point of view.

Mirce-mechanics Analysis of Functionability of NASA-contracted Commercial Re-supply Services

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The main purpose of this paper is to apply Mirce-mechanics to the analysis of functionability of Space Exploration Technologies Corporation and Orbital Sciences Corporation, organizations that have been selected by NASA to participate in the Commercial Orbital Transportation Services, COTS. The reason for this is the fact that at the moment of writing this paper, both CRS Programmes are out of action due to catastrophic launch failures that took place on 28th June 2015 and 28th of October 2014, respectively. It is expected that analysis performed on the past missions, conducted by both corporations, based on the publicly available information, will get incites into their practices and experiences gained, as well as highlighting the areas of potential applications of the Mirce-mechanics based knowledge to increase in the probability of the successful continuations of NASA-contracted Commercial Resupply Services.

Aircraft Air-intake Icing on the Ground as a Mechanism of the Motion in Mirce-mechanics

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Mirce-mechanics is a scientific theory of the motion of maintainable systems through Mirce Spacetime resulting from any actions whatsoever and the actions required to produce any motion accurately proposed and demonstrated. Hence, the main purpose of this paper is to address the air-intake icing as a mechanism of the motion in Mirce-mechanics that causes the transition from the positive to the negative in-service state of an aircraft. To address this mechanism the Loganair scheduled cargo flight for the Royal Mail, from Edinburgh-Turnhouse Airport, Scotland to Belfast International Airport, has be selected for the analysis. The flight took place on 27th February 2001, with 17.10 take off and ditching into water several minutes later, killing both crew members A few other examples, where this mechanism caused the transition to the negative state, with similar consequences, are also mentioned in the paper.

Aerotoxic Syndrome as a Mirce-mechanics Phenomenon

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Abstract

Mirce-mechanics is a scientific theory of the motion off maintainable systems through Mirce Spacetime, resulting from any failure causes whatsoever and the actions required to produce any motion accurately proposed and demonstrated. Hence, the main purpose of this paper is to address the impact of toxic aircraft materials that cause in-service effects such as blurred vision, disorientation, memory loss, lack of coordination, nausea and similar to flight crew and frequent flyers. Aerotoxic Syndrome is the term given to the adverse health effects resulting from the exposure to jet oil mist during commercial flights. There are some indications that methods of Mirce-mechanics could be used to make flying as safe as possible, while ensuring wellbeing for crew members and frequent flyers.

Simultaneous Multiaxis Shaking

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"Testing leads to failure, and failure leads to understanding." - Burt Rutan

Over about 60 years, first in Connecticut with an electrodynamic shaker (MB) manufacturer, then travelling the world from a California base as Tustin Institute of Technology, then as Tustin Technical Institute and currently as Equipment Reliability Institute, I've had the pleasure of introducing new instrumentation and test engineers and technicians to the basics of mechanical vibration.

Many of those test engineers and technicians progressed to conducting vibration tests, using mechanical, servo-hydraulic and electro-dynamic shakers. Their supervisors hoped that those tests simulated (and slightly exceeded) "real world" seismic, vehicular and/or flight vibrations. If their hardware survived the specified vibration test, it was hoped, their hardware would survive "real world" in-service vibrations.

But how could that be? The *vast* majority of shakers vibrates nominally in one-axis-at-a-time. Even though, when we measure "real world" vibrations, usually using numerous accelerometers, we find simultaneous-all-axes vibrations. So that several (at least three) shakers must *simultaneously* shake our hardware. Multiple-shaker systems, recently become available, are finding more of our existing hardware weaknesses.

Simultaneous multiaxis shaking. When will your lab commence?

Troubleshooting as a Mechanism of Motion in Mirce-mechanics

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Abstract

The purpose of a paper is to address the troubleshooting, an activity performed by maintainers to identify failed component or module, as a mechanism of the motion of a maintainable system through the Mirce spacetime. For effective maintenance troubleshooting, as one of the main drivers of the "speed" of moving through negative functionability state, is essential element of any corrective maintenance task. To successfully perform troubleshooting tasks maintainers must possess both the knowledge and skills to find and fix problems efficiently. Many years of research, on-the-job observations, and common experience have demonstrated that it is much easier to teach and learn manual skills than troubleshooting skills. The paper clearly demonstrates that troubleshooting is a complex subject as it is driven by both sides of equation, namely system designers that conceive troubleshooting processes and maintenance managers that manage them during the life of a maintainable system.

Book Review

Book Title: **Managing Complexity**
Authors; **George Rzevski and Petr Skobelev**
Publisher: WITpress, 2014
Cover: Hard, 198 pages.
ISBN: 978-1-84564-936-4

Review by Dr J. Knezevic, MIRCE Akademy, Woodbury Park, Exeter, UK.

Behaviour of swarm of bees, birds, fish and other animals is frequently used to illustrate the behaviour of complex systems. Unique property of this behaviour is an emerging performance and power of the swarm resulting from the strong interactions of a large number of contributing elements. This book is the best example of that type of behaviour. It is consists of 19 chapters, each of which standing alone is inadequate to represents the beauty, power and necessity of understanding and managing complex systems. However, all together .nicely interwoven, represent a beautiful book that tells the unique story created by two talented researches and entrepreneurs.

The book is a product of the new way of looking and understanding the behaviour of the systems around humans that, up to now, have been characterised as either deterministic or probabilistic. Authors, in the opening chapter, clearly delineated the existence of the large number of systems in domains of banking, natural environment, politics, technology, communication, transportation, engineering and others that shape our lives, in the manner where the future is neither uniquely and precisely determined, nor is "totally unpredictable", which is defined as the random behaviour. This realisation ignited a curiosity spark that guided both authors towards research focused on the understanding of this complex behaviour of surrounding systems. The research performed culminated in the creation of the new body of knowledge, necessary to assist humans in day to day living in and being subjective to the emerging behaviour of these systems. Seven criteria of complexity, identified by the authors, clearly defined unique behaviour of complex systems that led them to the conclusion that their emerging behaviour cannot be controlled, but it could be managed "*by coping with external complexity and tuning internal complexity*".

Methods for managing complexity, according to the authors, should be focused on the creation of the adaptive properties of complex systems. The process of "engineering" adaptability of complex systems has been clearly presented in this book, through seven interrelated and integrated steps. This uniquely led to the creation of multi-agent technology, which is a software technology dedicated to the creation of the virtual world in computers where agents communicate, collaborate and create information that is used in the real world for decision-making under constrains like budget, weight, time, volume, distance or combination of them.

Finally, the large number of real commercial applications, developed and applied by the authors and their team of programmers, which used methods and "tools" presented in the book, clearly demonstrate their befits to the daily lives of humans. The examples presented are related to the process of managing complexity of manufacturing systems, space station operation, aircraft wing design, London taxies scheduling, high-speed railway planning, adaptive management of service teams, to mention a few, all of which have delivered the monetary savings, increased safety and reliability of operations, better utilisations of resources available, higher customers satisfaction of other measure of the key performance of complex systems considered.

At the end of the book, authors clearly have presented their view of the future that is continuous increase in complexity of systems, which could be managed only by extensive, internet based, connectivity of “things” within the complex systems, which will start communicating and managing the system complexity without involving humans. Hence, in the view of authors, cars, trucks, railways carriages, airplanes, plants, shops, warehouses, spare parts, assemblies pallets and “million” other things will drive complex systems of the future through exchange of information in real time, all the time, leading to autonomous decision-making.

In summary, this book represents the new view of the systems that drive business world whose complexity has exceeded the capability of humans, however experienced and motivated, to manage it in the manner that improve business outputs regarding any criteria that is consider important. It is original, it is refreshing, it is brave and it will benefit all those who are able to change their minds, based on the current, well established and hardly ever challenged, believe that future is predictable and controllable.

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- Applications of existing Mirce-mechanics knowledge
- Observational knowledge that could be beneficial for further developments of Mirce-mechanics
- Reports, book reviews and short news that are of a general benefit to Mirce-mechanics

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