



“Mechatronic Rehabilitation” and “Bionic Artificial Organs” in “Medical Technique” Applications

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Abstract

Dr. Elmas uses the concept of “mechatronic rehabilitation” when designing these solutions. In other words, the device is not just an assistive tool, but is designed like a bionic part that works in harmony with the patient’s nervous system.

Dr. Emin Taner Elmas’s proposed mechanical solutions for SMA (Spinal Muscular Atrophy) patients are based on biomechanical systems developed to increase patients’ mobility and improve their quality of life. Here are the cornerstones of these solutions:

1. Smart Exoskeleton Systems: *In SMA patients, muscles cannot receive signals and weaken due to motor neuron loss. The mechanical solution Elmas focuses on is a support exoskeleton attached to the outside of the body:*

- **Artificial Muscle Support:** *Micro-motors and actuators placed at joint points mechanically perform walking, sitting, or arm lifting movements that the patient cannot do with their own strength.*
- **Sensor Integration:** *Sensitive sensors that detect the movement the patient wants to make (for example, shifting the center of gravity to take a step) instantly activate the mechanism.*

2. Neuromuscular Stimulation (Electrical Stimulation): *It offers a structure integrated with a mechanical system to not only provide external support but also prevent complete muscle atrophy:*

- **Muscle Activation:** *While the exoskeleton moves, low-voltage signals are simultaneously sent to the muscles. This aims to slow down the atrophy (muscle wasting) process by preventing the muscles from remaining passive.*

3. Spine and Posture Support (Scoliosis Prevention): *Spinal curvature (scoliosis) is very common in SMA patients due to muscle weakness. Elmas’ designs offer a mechanical solution to this problem:*

- **Dynamic Bracing:** *Unlike traditional rigid braces, it envisions flexible and mechanically supported structures that allow body movement but keep the spine in proper alignment.*

4. Respiratory Support Mechanisms

Because respiratory muscles weaken in the advanced stages of the disease:

- **Portable Ventilator Integration:** *It is working on lighter and more efficient mechanical respiratory support units that are integrated into the exoskeleton or wheelchair system and do not restrict the patient’s movement. The Difference in Engineering Approach. [1-54]*

Keywords: *Medical Technique, Medical Thermodynamics, ELMAS’s Theory of Thermodynamics, 5th Law of Thermodynamics, Thermodynamic, Energy Transfer, Fluid Mechanics, Heat Transfer, Mathematics, Applied Medi-Brain Energy Tronic, Bionic Eye, Mobile Bio-Eye-Tronic, Bio-Artificial Liver Organ, Mechatronic Rehabilitation, Bionic Artificial Organs, Neuro-Engineering, Neuro-Science, Neurological Diseases, SMA Disease, Artificial Heart, Neuromuscular Stimulation, Smart Exoskeleton Systems, Posture, Biomechanics, Bionic Limbs, Prostheses.*

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INTRODUCTION

Dr. Emin Taner Elmas is working on a wide range of bionic organs and systems that mimic not only the liver but also other vital functions of the body. His other significant projects, which combine mechanical engineering with biomedicine, include:

Artificial Heart Design [1-54]

Similar to the liver project, it focuses on a mechanical support system for patients suffering from heart failure.

- Mechanism: It is a bionic pump design that provides continuous and rhythmic blood flow and maintains intra-body pressure balance.
- Aim: To act as a “bridging” or create a permanent support unit for patients awaiting heart transplants.

Bionic Eye [1-54]

This project, developed for individuals experiencing vision loss, aims to convert optical data into electronic signals.

- Technology: It is based on a sensor layer that detects light and a microchip architecture that transmits this data to the nervous system.
- Aim: To enable patients with damaged photoreceptor cells (e.g., retinitis pigmentosa) to regain some limited vision.

Neuro-Physical Therapy Designs for SMA Disease [1-54]

Dr. Elmas proposes engineering-based solutions for SMA (Spinal Muscular Atrophy), a genetic disease.

- Approach: It is based on exoskeletons or neurostimulatory mechanical systems that support nerve-muscle transmission and aim to slow muscle loss.

Bionic Limbs and Prostheses [1-54]

He also works on advanced prosthetic designs that mimic body mechanics and offer more natural movement capabilities. In these designs, mechatronic control and material strength (carbon fiber, etc.) are particularly important.

MATERIAL, METHOD AND DISCUSSION

Dr. Elmas’s projects are generally interdisciplinary; that is, he adapts the pressure control technology he uses in one project (for example, in a liver device) to manage the circulatory system in another project (such as an artificial heart). [1-54]

These two projects of Dr. Emin Taner Elmas aim to support the nervous and muscular systems of the human body with mechanical solutions. Here are the technical and medical details of both projects:

Bionic Eye Design [1-54]

This project was developed specifically for patients whose photoreceptor cells (light-sensing cells) are damaged but whose optic nerves are intact (e.g., Retinitis Pigmentosa).

- Working Mechanism: A micro-camera placed on a pair of glasses captures images from the outside world. These images are converted into electrical signals by a processor.
- Signal Transmission: The converted signals are transmitted to an array of electrodes surgically implanted on the retina or optic nerve.
- Bionic Intervention: These electrodes stimulate the remaining optic nerves, sending “image” information to the brain. The patient begins to perceive the outlines of objects and changes in light.
- Goal: To enable individuals with complete blindness to regain enough vision to move independently.

Neuro-Physical Treatment Approach for SMA [1-54]

SMA (Spinal Muscular Atrophy) is a genetic disease that leads to muscle wasting due to the loss of motor neurons. Elmas’s approach to this involves a mechatronic exoskeleton and an electrical stimulation system.

- Exoskeleton Support: This is a motorized and sensor-equipped external structure design that supports the joints of SMA patients with insufficient muscle strength. This system mechanically completes movements that the patient cannot perform (walking, arm lifting).
- Neuro-Muscular Stimulation: A system is integrated that stimulates nerve endings or muscles directly with low-voltage electrical signals to slow down muscle loss.
- Physical Stabilization: The design has a balancing mechanism that holds the body in the biomechanically correct position to prevent spinal curvature (scoliosis). Key Difference
- While the Bionic Eye aims to replace a sensory organ;
- The SMA solution aims to provide external mechanical and electrical support to the existing muscle and nervous system.

Asst. Prof. Dr. Emin Taner Elmas’s Bionic Eye project is a vision prosthesis design that aims to restore visual perception in visually impaired individuals through mechanical and electronic methods. The technical layers of the project are as follows:

Basic Components of the System [1-54]

The design consists of three main parts to transmit the image from the outside world to the brain:

- Micro Camera: Usually mounted in a glasses frame. It captures real-time images.
- Image Processing Unit (VPU): A microchip that converts the digital data from the camera into electrical impulses that the nervous system can understand.
- Electrode Array (Implant): A unit that triggers nerve cells, surgically implanted in the retina or on the optic nerve.

Working Mechanism [1-54]

The project mimics the biological vision process in the following steps:

1. Light Detection: The camera captures the image.
2. Wireless Data Transfer: The processed data is wirelessly sent to the receiver implanted in the eye via a transmitter on the edge of the glasses.
3. Neural Stimulation: The receiver transmits the incoming signals to the electrodes. These electrodes stimulate the remaining optic nerve cells, sending “flashes of light” (phosphenes) to the brain.
4. Image Formation: The brain interprets these electrical stimuli as meaningful shapes, lines, or points of light.

Target Patient Group [1-54]

This design is not suitable for all types of blindness. It specifically targets patients with the following conditions:

- Retinitis Pigmentosa (Night Blindness): Cases where photoreceptors are dead but the optic nerve is intact.
- Macular Degeneration: Advanced vision loss.

Engineering Approach [1-54]

Dr. Elmas emphasizes mechatronic control systems in this project. The focus of the design is to increase the resolution of the external image and to ensure that the electrodes stimulate with the highest efficiency without damaging nerve tissue.

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Smart Exoskeleton Systems [1-54]

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Neuromuscular Stimulation (Electrical Stimulation) [1-54]

It offers a structure integrated with a mechanical system to not only provide external support but also prevent complete muscle atrophy:

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voltage signals are simultaneously sent to the muscles. This aims to slow down the atrophy (muscle wasting) process by preventing the muscles from remaining passive.

Spine and Posture Support (Scoliosis Prevention) [1-54]

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Respiratory Support Mechanisms [1-54]

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- Portable Ventilator Integration: It is working on lighter and more efficient mechanical respiratory support units that are integrated into the exoskeleton or wheelchair system and do not restrict the patient’s movement. The Difference in Engineering Approach

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In Dr. Emin Taner Elmas’s SMA solutions, these two critical engineering problems (scalability and energy) are at the heart of mechatronic design:

Scalability for Pediatric Patients (Modular Design) [1-54]

Since SMA is usually diagnosed in infancy and childhood, the device needs to adapt to the child’s growth. Elmas’s approach is as follows:

- Telescopic Exoskeleton Structure: The arm and leg lengths of the device can be extended in parallel with physical growth using screw or rail systems.
- Adjustable Joint Torque: As the child grows and gains weight, the support force (torque) applied by the micro-motors placed in the joints is increased software-wise.
- Lightweight Composite Materials: To avoid excessive load on the children’s bone structure, high-strength but very lightweight materials such as carbon fiber and aluminum alloys are preferred in prototypes.

Energy Requirements and Battery Management [1-54]

The biggest problem of a portable exoskeleton is heavy batteries. Elmas aims to overcome this problem with the following methods:

- High-Density Lithium-Ion/Polymer Cells: Lightweight but long-lasting battery packs are usually placed in a “balancing bag” on the back.
- Regenerative Braking (Energy Recovery): Just like in electric vehicles, the mechanical energy generated by gravity

when the patient takes a step or goes downhill is recycled to charge the battery.

- **Low Power Consumption Algorithms:** The system only provides full power in “critical moments” when the patient’s muscle strength is insufficient; during stationary moments, it switches to “sleep mode” or “minimum support” mode to conserve battery life.

User Interface and Smart Control [1-54]

- **Mobile Application Integration:** Parents or physical therapists can monitor how much support the device is providing and the battery status in real-time via an application.
- **Wireless Charging:** The device is planned to be wirelessly charged overnight in a unit near the patient’s bed or on a special stand.

CONCLUSION

Dr. Elmas’s mechatronic rehabilitation solutions are based not just on connecting the patient to a machine, but on making the machine a part of the patient’s body (bionic integration).

Elmas’s Thermodynamic Theory, related to the 5th Law, addresses neurological diseases as an energy and mass imbalance (increase in entropy) at the cellular level, going beyond the classical medical approach.

Thermodynamic Approach in Neurological Diseases: [1-54]

Diseases such as Alzheimer’s and Parkinson’s are characterized by the loss of neuron function and the inability to clear cellular “waste” (such as amyloid-beta plaques). According to Elmas’s theory, this situation is explained as follows:

- **Negative Mass and Energy Dominance:** While a healthy neuron is in a “neutral” or “stable” equilibrium, in the disease process, negative mass and negative energy components become dominant. This means the cell self-depletes and loses function.
- **Vector Imbalance:** The decrease in beneficial substances (positive mass) that should enter the cell and the accumulation of toxins (negative mass) that should be eliminated disrupts the vector balance of the system.
- **Entropy and Neurodegeneration:** From a 5th Law perspective, these diseases are an uncontrolled increase in the disorder (entropy) of the system. The treatment approach focuses on restoring balance by making an external “vector intervention” (drug or energy transfer) to the system.

This theory provides a mathematical model to calculate not only the chemical effect of neurological drugs but also how they alter the total energy capacity of the cell. According to Elmas, recovery is only possible when the input of energy and substances in the “positive” direction dampens the “negative” vector created by the disease. [1-54]

BIOGRAPHY OF AUTHOR

Asst. Prof. Dr. Dipl.-Ing. Emin Taner ELMAS



Asst.Prof. Dr. Emin Taner ELMAS is a Mechanical Engineer having degrees of B.Sc., M.Sc., Ph.D., and was born in Sivas in 1974. He completed his doctorate at Ege University, Graduate School of Natural and Applied Sciences, Mechanical Engineering Department, Thermodynamics Science Branch, and his master’s degree at Dokuz Eylül University, Mechanical Engineering Department, Energy Science Branch. He also completed his undergraduate education at Hacettepe University, ZEF, Mechanical Engineering Department and graduated from the faculty with honors in 1995 and became a mechanical engineer. He was awarded a non-refundable scholarship by the Turkish Chamber of Mechanical Engineers in his 4th year because he was the most successful student during his first 3 classes study at the faculty. He graduated from İzmir Atatürk High School in 1991.

Asst. Prof. Dr. ELMAS has completed his military service as a NATO Officer in Bosnia and Herzegovina. He was a “Reserved Officer” as a “2nd Lieutenant” as an “English-Turkish Interpreter”. He was also a “Guard Commander” and served in Sarajevo, Camp Butmir within the SFOR task force of NATO. He has been awarded with 2 (two) NATO Medals and Turkish Armed Forces Service Certificate of Pride (Bosnia & Herzegovina).

In addition to his academic duties at universities, he has worked as an engineer and manager in various industrial institutions, organizations and companies; He has served as Construction Site Manager, Project Manager, Management Representative, Quality Manager, Production Manager, Energy Manager, CSO-CTO, CBDO, Factory Manager, Deputy General Manager and General Manager.

Asst. Prof. Dr. Elmas is Department Head and is an Assistant Professor of Automotive Technology at the Department of Motor Vehicles and Transportation Technologies at Vocational School of Higher Education for Technical Sciences at IĞDIR UNIVERSITY, Turkey. He is also an Assistant Professor of Bioengineering & BioSciences at the same university. He has nearly 30 years of total experience in academia and in industry.

He has served as a scientific referee and panelist for ASME, TÜBİTAK and many scientific institutions, organizations and universities, including NASA.

He has published numerous international and national academic scientific articles, books, and book chapters, and serves as an editor for international academic journals. He also serves on the scientific committees of many international conferences, publishing conference and congress proceedings and giving presentations.

“Mechanical Engineering, Energy Transfer, Thermodynamics, Fluid Mechanics, Heat Transfer, Higher Mathematics, Evaporation, Heat Pipes, Space Sciences, Automotive, Bioengineering, Medical Engineering Applications, Neuroengineering, Medical Technique” are his academic and scientific fields of study; “Heating-Ventilation Air Conditioning Applications, Pressure Vessels, Heat Exchangers, Energy Efficiency, Steam Boilers, Power Plants, Cogeneration, Water Purification, Water Treatment, Industrial Equipment and Machinery, Welding Manufacturing, Sheet Metal Forming, Machining” are his industrial experience fields.

As of 2026, he has been awarded the Nobel Scientist Award by the international platform organization Scientific Laurels.

Asst. Prof. Dr. Emin Taner ELMAS is also a musician, saz (baglama) virtuoso player and ney (Nay, Turkish Reed Flute) performer. He plays also cümbüş instrument and performs darbuka rhythm instrument. He has a YouTube Music Channel (Emin Taner ELMAS) which includes some of his sound recordings of him playing the saz-baglama and blowing the ney. He composed the poem written by the great poet Âşık Veysel ŞATIROĞLU under the name of “Raşit Bey” in memory of his father Judge (Hâkim) Raşit ELMAS as “Raşit Bey Türküsü”, wrote it down, notated and published it as an academic article and broadcasted this song on his own music channel. He wrote the poems entitled “Canım Babam” and “Geldim Babam” which he wrote also in memory of his father and published in an academic literature journal, and composed instrumental musics for these poems. He also composed an instrumental song called “Annem Annem Türküsü” and gave it to his mother, Lawyer Tuna ELMAS, as a gift on Mother’s Day, 11.05.2025. He also has a poem titled “Ney and Neyzen.” He also wrote and presented a poem titled “Esra Kardeşim” to his sister, Esra ELMAS, an archaeologist and English teacher. He has published books including “Saz-Bağlama Tuning System Method” (“Saz-Bağlama Akort Sistemi Metodu”) and “Ney and Neyzen; Ney’s Pitches, Frets, Sound Stages, Octaves, Structure, Performance, Ney Maintenance and Basic Music Theory” (Ney ve Neyzen; Ney’de Perdeler, Ses Devreleri, Oktavlar, Yapısı, İcrası, Ney Bakımı ile Temel Müzik Nazariyatı) and My Collection of Literary and Musical Art Works – I Story / Anecdote / Essay / Poetry / Verse / Prose / Humorous; witty - satirical; poetic stories / Lyrics / Composition (Edebiyat ve Müzik Sanat Eserleri Külliyyatım – I Hikâye / Anekdote / Deneme / Şiir / Manzume / Nesir / Mizahi; nükteli – hicivli; şiirsel hikâyeler / Güfte / Beste). He continues his artistic studies by writing various articles, books, poetry, lyrics and also realizing musical composition and repertoire works.

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