

**Dear Mr. Chairman,
Dear Colleagues,
Ladies and Gentlemen**

Today's ceremony is a very important event in my professional life.

It is great honor for me to be a recipient of this prestigious award, thank you very much. The list of the previous awardees of Rovira i Virgili University is the best evidence of its highest prestige. I am really proud to be among them. To my knowledge, I am the first engineer in the list of award recipients and I am thankful to the international recognized group of top-level experts in power electronics and control, headed by Prof. L. Salamero Martinez, for high evaluation of my work.

First of all I would like to mention some important events and people, who supported me, believed in me, illuminated my way for years and years.

The first important event: the math teacher in my Moscow high school. The teacher demonstrated that the structure of an exact science has much in common with art, even more, esthetics is inherent not in art only, but may be found in many chapters of a such well formalized science as mathematics.

He explained to us that the starting point for mathematics is a set of axioms, like seven notes in music. And then – like a new melody from the seven notes, the new building of mathematical knowledge is erected from the axioms. But how? Nobody knows. It stems from talent, fantasy, ability to see the final result. Is it in a different way in music? Also talent, also fantasy, also ability to hear a new melody.

The teacher had a surprising gift to see beauty in the conventional chapters of our textbook. How many times we heard his famous “Oh, how boring!” interrupting a monotonous narration of one of us about a well prepared home work let's say about ellipses, hyperbolas, parabolas. The teacher continued: “Do not worry” – to the pupil, “Your grade is “A”, but sit down”.

He took a piece of chalk, approached the blackboard, drew a cone and crossed it by a plane. Then he changed a slope of the plane. Suddenly without a single formula, as from the hands of a magician, the same ellipses, hyperbolas, parabolas appeared on the cone surface. It was like in an art gallery. What was the most important, he appealed to non-trivial ways of thinking, better to say, to an independent way of thinking, which is absolutely necessary for a researcher. I believe it was exactly what great Einstein meant when he said: "Education is what remains in your brain after you forget what you learnt at University".

It was great luck for me to work for dozens of years at IPU (Institute of Control Sciences), the oldest Institute in control area, founded in Moscow in 1939. It was a real wonderful island in the soviet environment, better to say a wonderful kingdom with absolute democracy. "Kingdom with absolute democracy"! Sounds strange. Does not it? But it was the case, because everybody could become a king or queen should he or she approaches the scientific truth closer than the others. The scientific truth was the only God there.

You know that integration of the Russian science into the world science in the iron curtain times met some obstacles. Although we had published our first results on the sliding mode control (it is my area) by the mid of 70's, they were practically unknown to our colleagues of the West countries. I am thankful to my colleagues and friends of University of Illinois for the invitation to work with them during my sabbatical of 1975-76. They helped my orientation in the new environment, introduced me to the control community, gave me a chance to tell about what we were doing in Moscow. Our today's international multi-branch sliding mode control tree was seeded at that time. Now we get together for our workshops every two years. The previous ten were held in 4 continents, one of them in Spain. No doubt that Illinois was a milestone event in my professional life.

All my professional life I did what I liked to do and every morning went to my office in a good mood, anticipating the pleasure to stay in the kingdom I have spoken about. After the collapse of the Soviet Union the continuation seemed problematic because of the natural financial difficulties of the transition to the market economics. My good friends extended that wonderful time of "free search" inviting me to work at the Ohio State University. Before and after joining the OSU I have had the same opportunities holding visiting positions at

universities and research centers of different countries. My sabbatical time at URV was so inspiring and exciting both from professional point and personal contacts. I am happy to keep them until now.

Now I am with OSU and should say some words about what research I am doing. I doubt that it is a good moment to tell about our boring engineering business, it will contradict celebration atmosphere of the current event.

Probably you noticed that the word “art” appeared in narration. I believe that majority of guests in this room are involved into research activity. When getting older I ask myself more and more often: science is not the only creative area of human activity; literature, music, painting are other examples; are these areas similar to what we do? what is difference or similarity in our objectives, processes of approaching them? to what extent are our results of interest to public? In the framework of these questions I would like to confine myself to discussion of two concepts “science” and “art” only.

Definition

The first evident definition of the territories for those concepts is the following: logic – for science, emotions – for art. But I believe that it is the first, very inaccurate approximation. There exists no high brick fence between the two territories, no doubt that mutual penetration of science and art can not be denied. Of course my expertise in art is not sufficient to perform a deep analysis of that mutual influence. I will speak only about my own observations and only about what I learnt from the thoughts of outstanding representatives of science and art. My vision of the different aspects of the concept “science-art” may look doubtful, many questions caused by my observations are still unanswered. But I do not worry about this. Anyway doubts and unanswered questions are common in the world of art.

The first aspect of the topic

Objectives

Science: to explain the phenomena of our world, to discover new phenomena, to develop new theories, which can be consumed directly by other people for further research, experiments, practical needs. In a nutshell – the objective is to make absolutely clear what has

been unclear or even unknown and to represent the results of the research as well formalized knowledge.

Art: I am not sure whether the objective may be explained even by an author of a book, a composer, a painter. Leo Tolstoy once said: “If you can refrain from writing fiction, do”. So in my opinion, a writer writes, a composer composes, a painter paints only because they cannot refrain from, and the question “What for?” is secondary for them. Maybe “the research’ is the way of life for scientists as well but they always know “For what”. One more serious difference. In contrast to science with the final objective – formalization, any formalization ruins the art. Moreover many masterpieces of art leave a lot of questions unanswered. Readers, listeners, spectators are delighted of them and can not even explain “Why”. Like love. It is not love if you can give an EXHAUSTIVE answer why you love. Mystery, secret should be inherent in art like in love. Scientists are always eager to reach maximum of likelihood between the real world and results of research. However the identity of the real life and art works would be disappointing like a photo for a document. In the opinion of Spanish painter Goya, any portrait should reveal the inner world, which is much more important than to paint a carbon copy of a model. One and half century before Goya, in the inquisition times such position could be dangerous. While observing his portrait by Velazquez, pope Innocent discovered in it those features of his personality, he would have liked to hide from other people. Fortunately he said only: “Troppo vero” (too real).

Each of us has his or her own view for a real masterpiece, these views can be opposite and it is not a trouble. May be because of that people say “My Chopin”, “My Chekhov”, even “My Paris”. And I have never heard “My Newton” or “My Faraday”.

People of Art and People of Science.

I have always observed the difference in mentality between the ones and the others . Representatives of art find the sources of inspiration in human society, personal life experience. As to scientists, many of them suffer of the illness called “autism”. They may loose

good contacts with human community, they have a very high ability for abstractions, deduction logic (like the main hero played by Dustin Hoffman in the movie “Rain man”; I remind you that he demonstrated a very high intellectual level for calculations with big numbers and at a card table along with the symptoms of a mental illness). The bright examples are Einstein, Newton, Boltzmann. Einstein’s voluntary isolation of himself met hostility of University professors, they did not offer him to remain at the university with them for continuing research after the graduation and he worked in a patent bureau (of course you know that his autism symptoms disappeared at his mature age). Of course I speak about a tendency only. The traces of autism may be found in the people of art as well, in particular, in musicians and painters.

One more interesting aspect of the comparison. Many outstanding scientists were excellent amateurs in art. Einstein played violin, famous American physicist Richard Feynman loved to play African instrument bongo drum. We can admit that Sherlock Holmes was a scientist as a founder of deduction method in criminal science; he played violin as well.

But I do not know examples, when a professional violinist enjoyed proving mathematical theorems as a hobby. Of course it is a joke: a violinist plays for everybody including a mathematician, but a mathematician proves his theorems for a very limited number of people and anyway not for a violinist.

About the Processes

Undoubtedly the processes of reaching or approaching to new knowledge in science and composing music, writing books, painting pictures are the most enigmatical in our discussion. I believe that they are practically identical in science and in art: they are creative, they need inspiration, they need special state of a creator. And in addition for the both areas the question “How could it be done?” does not have answer – no formalization, no recommendation, what should be done such that inspiration would visit you. As I mentioned when recollecting my math school teacher, like art masterpieces, a new building in science, beauty of its floors comes from ability, talent, ingenuity of the creator.

Another aspect of a creative activity in science and art. A scientist works with a model rather than with the real life or creates these models. They handle the models as axioms and the

axioms serve as a starting point for moving to the new knowledge. But sometimes the axioms can lead a researcher to a dead-end. The famous Russian physicist of 20-30s Mandelshtam said once: “Be careful. Your model can revenge for itself”. Probably those dead-ends explain the interesting observation of English philosopher Bertrand Russel: “It is a curious fact that just when the man in the street has began to believe in science, while the man in the lab. has began to loose his faith”. How to find the ways out of the dead-ends? From the first view, genius in science demonstrates the highest ability for the deepest and complete information processing much higher than those of the other people. Of course it is true. But they are in the science history due to another reason. Their contributions do not follow from the existing axioms. They created new ones which can not be obtained logically: Newton’s laws, the relativistic theory by Einstein. Two centuries ago the great Russian poet Pushkin expressed this thought in three words: *Genius is a friend of paradoxes*. I doubt that it can be formulated better.

(О сколько нам открытий чудных

Готовят просвещенья дух

И опыт, сын ошибок трудных,

И гений, парадоксов друг)

What is art in the context “axioms and geniuses”? I find certain similarity in situations with science and art. There exist axioms in arts as well, better to call them dogmas. The religious dogmas dominated in the pre-renaissance period. Then they were, maybe not disregarded completely, but revised by genius artists of Italy. On one hand, it was a period of revival of the classic forms of Greek and Roman art, but on the other hand, the new dogmas (although this word sounds terrible for the full of optimism renaissance time, I would rather call them cannons) reflected interest to humanism, assertion of the importance of the individuals, landscapes, distant mountains, cloud-filled sky.

So we can find more similarities than differences when speaking about creative processes in science and art.

“Product” of Science and Art

The difference is evident. We have already mentioned that the product of science is oriented towards a rather limited number of people – experts in the area. As to art, everybody can enjoy its masterpieces. They are everlasting. Mona Lisa by Leonardo Da Vinci was painted in

the very beginning of the 16th century. And since then century after century people stop motionless and speechless with admiration of her mysterious smile.

The destiny of scientific knowledge is much more modest. It has only one instant of celebration – the instant of its birth. Before - it is known to nobody, after – it is trivial for everybody. Faraday's laws are two hundred years younger than Mona Lisa, but you would hardly meet somebody's admiration of them now.

In conclusion, the question which has proved to be out of our talk. *Where are the highest peaks of human inspiration?*

The first possible answer – in science - when the objectives are to make all phenomena under study and new theories absolutely clear

or

The second answer – in art – when this inspiration leaves many questions open and only appeals to intellectual activity, maybe revision of someone's philosophy, only reveals subtle aspects of a human soul and human relations.

Probably my question is not legitimate and the peaks of science and art are not comparable. But why the great thinkers of the human history tried to answer this question? The great orator Cicero said: "I prefer to be wrong with philosopher Plato, than to be right with mathematician Pithagore". What do I prefer? I do not know. Let me finish my presentation with this unanswered question.

Thank you.