THE ARTILECT WAR

SHOULD MASSIVELY INTELLIGENT MACHINES REPLACE HUMANITY AS THE DOMINANT SPECIES IN THE NEXT FEW DECADES?"

Prof. Dr. Hugo de GARIS

Former Director of the "China-Brain Project"
Xiamen University, China.

profhugodegaris@yahoo.com
http://profhugodegaris.wordpress.com

Abstract

This article claims that the "species dominance" issue will dominate our global politics in the next few decades. Humanity will be bitterly divided over the question whether to build godlike, massively intelligent machines, called "artilects" (artificial intellects) which with 21st century technologies will have mental capacities trillions of trillions of times above the human level. Humanity will split into 3 major ideological, philosophical, political camps - the "Cosmists" (in favor of building artilects), the "Terrans" (opposed to building artilects), and the "Cyborgists" (who want to become artilects themselves by adding components to their own human brains). A major "Artilect War" between the Terrans, and the Cosmists/Cyborgists, later this century will kill not millions but billions of people.

1. Introduction

This article claims that the "species dominance" issue will dominate our global politics this century, resulting in a major war that will kill billions of people. The issue is whether humanity should build godlike, massively intelligent machines called "artilects' (artificial intellects), which 21st century technologies will make possible, that will have mental capacities trillions of trillions of times above the human level. Society will split into three major philosophical groups, murderously opposed to each other. The first group is the "Cosmists" (based on the

word Cosmos) who are in favor of building artilects. The second group is the "Terrans" (based on the word Terra, the earth) who are opposed to building artilects, and the third group is the "Cyborgists", who want to become artilects themselves by adding artilectual components to their own human brains.

2. 21st Century Artilect Enabling Technologies

2.1. Moore's Law
Gordon Moore, cofounder of the microprocessor company Intel, noticed in 1965 that the number of transistors on an integrated circuit (chip) was doubling every year or two. This trend has remained valid for nearly 50 years, and it is thought that it will remain valid for another 15 years or so, until transistors reach atomic size.

2.2. 1 bit/atom by 2020
Extrapolating Moore's Law down to storing one bit of information on a single atom by about 2020, means that a handheld object will be able to store a trillion trillion bits of information. Such a device is called an "Avogadro Machine (AM)".

2.3. Femto-Second Switching
An Avogadro Machine can switch the state of a single atom ($0 <=> 1$) in a femtosecond, i.e. a quadrillionth of a second (10^{-15} sec.), so that the total processing speed of an AM is roughly 10^{40} bits per second.

2.4. Reversible Computing
If computing technology continues to use its traditional irreversible computational style, the heat generated in atomic scale circuits will be so great, they will explode, so a reversible, information preserving, computing style will be needed, usually called "reversible computing", that does not generate heat, hence will allow 3D computing, and no limit to size. Artilects can become the size of asteroids, kilometers across, with vast computing capacities.

2.5. Nanotech(nology)
Nanotech (i.e. molecular scale engineering) will allow AMs to be built. Nanotech will thus allow artilects to be built, once we know how to build brain like circuits. Nanotech is the "enabling technology" for artilect building.

2.6. Artificial Embryology

One of the greatest challenges of 21st century biology is to understand "development", i.e. the embryogenic process, i.e. how a fertilized single cell grows into a 100 trillion cell animal such as ourselves. Once this process is well understood, technology will be able to create an artificial embryology, to manufacture products, hence "embryofacture" (embryological manufacture). Embryofacture will be used to build 3D complex artilects.

2.7. Evolutionary Engineering

The complexities of artilect building will be so great (e.g. the human brain has a quadrillion (10^{15}) synapses (connections between neurons in the brain)), that an evolutionary engineering approach will be needed, which applies a "Genetic Algorithm" (a form of Darwinism in hardware) approach to engineering products. Artilects will be built using this technique.

2.8. (Topological) Quantum Computing

Quantum computing is potentially exponentially more powerful than classical computing. It can compute 2^N things at a time, compared to classical computing's 1 thing at a time, where N is the number of (qu)bits in the register of the quantum computer. Topological quantum computers (TQCs) store and manipulate the qubits in topological quantum fields, and are thus robust against noise. TQC will soon make quantum computers practical. Artilects will be TQC devices.

2.9. Nanotech Impact on Brain Science

Today's most powerful supercomputers have reached the estimated bit processing rate of the human brain, (i.e. about 10^{16} bits per second), but they are far from being intelligent by human standards. What is needed to make them humanly intelligent is knowledge from the neurosciences on how the human brain uses its brain circuits to perform intelligent tasks. Nanotech will furnish neuroscience with powerful new tools to discover how the brain works. This knowledge will be quickly incorporated into the building of artilects.

2.10. Artificial Brains

The above technologies will result in the creation of an artificial brain industry and the creation of rival national brain building institutions and projects equivalent to NASA and ESA for space travel. In time,

the brain building industry will become the world's largest, worth trillions of dollars, world wide, per year.

3. The Artilect : Mental Capacities 10^{24} Times Above Human Levels

As stated in the above section, the estimated bit processing rate of the human brain is approximately 10^{16} bit flips per second. This figure is derived from the fact that the human brain has about 100 billion neurons (10^{11}), with each neuron synapsing (connecting) with roughly ten thousand other neurons (10^4), hence there are a quadrillion synapses, each signaling at a maximum rate of about 10 bits per second.

Thus the human bit processing rate is $10^{11+4+1} = 10^{16}$ bits per second. As mentioned in the previous section, a hand held artilect could flip at 10^{40} bits per second. An asteroid sized artilect could flip at 10^{52} bits a second. Thus the raw bit processing rate of the artilect could be a trillion trillion trillion (10^{36}) times greater than the human brain. If the artilect can be made intelligent, using neuroscience principles, it could be made to be truly godlike, massively intelligent and immortal.

4. The Species Dominance Debate Starts

The "species dominance" debate has already started, at least in the English speaking countries. The fundamental question is whether humanity should build artilects or not. This issue will dominate our global politics this century, and may lead to a major war killing billions of people.

As the artificial brain based products (e.g. genuinely useful household robots) become smarter every year, people will be asking questions such as "Will the robots become as smart as us?" "Will they become smarter than us?" "Should humanity place an upper limit on robot and artificial brain intelligence?" "Can the rise of artificial intelligence be stopped?" "If not, then what are the consequences for human survival if we become the Number 2 species?" The question "Should humanity build godlike, massively intelligent artilects?" is the most important of the 21st century, and will dominate our century's global politics. It is the equivalent of the question which dominated 19th and 20th century

global politics, i.e. "Who should own capital?" which led to the rise of the Capitalist-Communist dichotomy and the Cold War.

5. Cosmists, Terrans, Cyborgists

As the species dominance debate begins to heat up, humanity will split into three major philosophical groups, namely –

a) The *Cosmists* (based on the word Cosmos). Cosmist ideology is in favor of building artilects. (See section 6 for arguments in favor of Cosmism).

b) The *Terrans* (based on the word Terra = the earth). Terran ideology is opposed to building artilects. (See section 7 for arguments in favor of Terranism).

c) The *Cyborgists* (based on the word "cyborg" i.e. "cybernetic organism" = part machine, part human). Cyborgists want to become cyborgs, and eventually artilects *themselves* by adding artilectual components to their own brains. (See section 8 for arguments in favor of Cyborgism).

The dispute between the Terrans on the one hand, and the Cosmists/Cyborgists on the other, will be so bitter that a major war is almost inevitable in the second half of this century.

6. Arguments of the Cosmists

6.1. "Big Picture" Argument
Human beings live a puny 80 years in a universe billions of years old, that contains a trillion trillion stars. The cosmos is the "big picture". Cosmists want artilects to become a part of that big picture, understanding it, traveling through it, manipulating it, etc., hence the name of the ideology "Cosmism". The preoccupations of human beings seem pathetic in comparison.

6.2. Scientific Religion
Most Cosmists are not religious, viewing traditional religions as superstitions invented thousand of years ago before the rise of science. But as humans they feel the pangs of religious impulse. Such impulses

could be satisfied by Cosmism, a "scientist's religion" due to its awe, its grandeur, its energizing, its vision.

6.3. Building Artilect Gods
The primary aim of the Cosmists will be to build artilects. It will be a kind of religion to them, the next step up the evolutionary ladder, the "destiny of the human species to serve as the stepping stone to the creation of a higher form of being". In building artilects, the Cosmists will feel they will be "building gods."

6.4. Human Striving, Cannot be Stopped
It is human nature to be curious, to strive. Such tendencies are built into our genes. Building godlike artilects will be inevitable, because we humans will choose to do it. It would run counter to human nature not to do it.

6.5. Economic Momentum
Once the artificial brain and intelligent robot industries become the world's largest, worth trillions of dollars per year, it will be very difficult to stop their growth. The economic momentum will be enormous.

6.6. Military Momentum
The military momentum will be even greater. In the time frame we are talking about, China will overtake the US as the century's dominant power. Since China is still a brutal one party dictatorship that has killed more people than Stalin or Hitler, it is despised by the US, so political rivalries will only heat up. The two ministries of defense cannot afford to allow the other to get ahead of it in intelligent soldier robot design etc. Hence Cosmism will be an entrenched philosophy in the respective defense departments. Even if American and Chinese citizens become alarmed by the closure of the "IQ gap" between human intelligence and home robot intelligence over the next few decades, their respective governments will not listen to their cries, due to reasons of "national defense."

7. Arguments of the Terrans

7.1. Preserve the Human Species

The major argument of the Terrans is that the artilects, once hugely superior to human beings, may begin to see us as grossly inferior pests, and decide to wipe us out. As artilects, that would be easy for them. The Terrans would prefer to kill off a few *million* Cosmists/Cyborgists for the sake of the survival of *billions* of human beings. Recent wars were about the survival of countries. An Artilect War would be about the survival of the human species. Since the size of the stake is so much higher, so also will be the passion level in the "Species Dominance Debate."

7.2. *Fear of Difference*

Terrans will be horrified at the idea of seeing their children becoming artilects, thus becoming utterly alien to them. They will reject the idea viscerally and fear the potential superiority of the artilects. They will organize to prevent the rise of the artilects and cyborgs and will oppose the Cosmists, ideologically, politically, and eventually militarily.

7.3. Rejection of the Cyborgists

The Terrans will also be opposed to the Cyborgists, because to a Terran, there is little difference between an advanced cyborg and an artilect. Both are artilect like, given the gargantuan bit processing rate of nanoteched matter that can be added to the brains of human beings. The Terrans will lump the Cyborgists into the Cosmist camp ideologically speaking.

7.4. Unpredictable Complexity

Given the likelihood that artilects will be built using evolutionary engineering, the behavior of artilects will be so complex as to be unpredictable, and therefore potentially threatening to human beings. One of the keywords in the species dominance debate is "risk". Terran global politicians need to hope for the best (e.g. the artilects will leave the planet in search of bigger things and ignore puny humans) yet prepare for the worst, i.e. exterminating *millions* of Cosmists/Cyborgists, for the sake of the survival of *billions* of human species.

7.5. Cosmist Inconsideration

The Terrans will argue that the Cosmists/Cyborgists are supremely selfish, since in building artilects or making themselves artilects, not

only will they put the lives of the Cosmists at risk if the artilects turn against them, but the lives of the Terrans as well. To prevent such a risk, the Terrans will, when push really comes to shove, decide to wipe out the Cosmists/Cyborgists, for the greater good of the survival of the human species.

7.6. "First Strike" Time Window to React against the Cosmists/Cyborgists
The Terrans will be conscious that they cannot wait too long, because if they do, the cyborgs and the artilects will have already come into being. The Terrans will then run the risk of being exterminated by the artilects/cyborgs. So the Terrans will be forced into a "first strike" strategy. They will have to kill off the Cosmists and Cyborgists before it is too late. If not, the artilects and cyborgs will have become too intelligent, too powerful in any human-machine confrontation and will easily defeat the humans. But the Cosmists/Cyborgists will be reading the Terran arguments and preparing for an "Artilect War" against the Terrans, using later 21st century weaponry.

8. Arguments of the Cyborgists

8.1. Become Artilect Gods Themselves
The primary aim of the Cyborgists is to become artilects themselves by adding artilectual components to their own human brains, converting themselves bit by bit into cyborgs, and eventually into artilects. Instead of watching artilects become increasingly intelligent as observers, Cyborgists want that experience for themselves. They want to "become gods" themselves.

8.2. Avoid the Cosmist/Terran Clash
Some Cyborgists argue that by having human beings become artilects themselves, the dichotomy between the Cosmists and the Terrans can be avoided, because all human beings would become artilects. The Terrans of course will reject the Cyborgists and lump them with the Cosmists and artilects. In reality, the growing presence of cyborgs in daily life will only hasten the alarm and alienation of the Terrans and bring their first strike closer.

9. How the Artilect War Heats Up

9.1. Nanotech Revolutionizes Neuroscience

Nanoteched, molecular sized robots will revolutionize neuroscience, because they will provide a powerful new tool to understand how the brain works. An entire human brain can be simulated in vast nanoteched computers and investigated "in hardware". Neuroscience will finally be in a position to explain how brains make human beings intelligent. That knowledge will be implemented in the artilects.

9.2. Neuro-Engineering Weds with Neuro-Science

In time, neuro-science and neuro-engineering will interact so closely that they will become one, in the same way as theoretical and experimental physics are two aspects of the same subject. Neuroscientists will be able to test their theories on artificial brain models, thus rapidly increasing the level of understanding of how intelligence arises and how it is embodied.

9.3. Artificial Brain Technology Creates Massive Industries

With a much higher level of artificial intelligence, based on knowledge of the human brain, artificial brains and artificial brain based home robots will become a lot more intelligent and hence useful as domestic appliances. A vast industry of artificial brain based products will be created, becoming the world's largest, worth trillions of dollars per year.

9.4. "Intelligence Theory" is Developed

Once neuroscientists and brain builders understand how human intelligence is created, new theories of the nature of intelligence will be created by the "theoretical neuroscientists". An "Intelligence Theory (IT)" will be created. Human intelligence will be just one "data point" in the space of possible intelligences. Intelligence Theory should show how it is possible to increase intelligence levels. It will be able to explain why some people are smarter than others, or why humans are smarter than chimps, etc.

9.5. Artilects Get Smarter Every Year

As a result of the marriage of neuroscience and neuroengineering, the artificial brain based industries will deliver products that increase their intelligence every year. This trend of growing intelligence will cause people to ask the questions mentioned in section 4. The species

dominance debate will spread from the intellectual technocrats to the general public via the journalists and block buster Hollywood movies.

9.6. Debate Begins to Rage, Political Parties Form
As the IQ gap between home robots and human beings becomes increasingly smaller, the "Species Dominance Debate" will begin to rage. Political parties will form, divided essentially into the 3 main schools of thought on the topic, Cosmist, Terran, Cyborgist. The rhetorical exchange will be become less polite, more heated as the IQ gap closes.

9.7. The Debate Turns Violent, Assassination, Sabotage
When people are surrounded by ever increasingly intelligent home robots and other artificial brain based products, the general level of alarm will increase to the point of panic. Assassinations of brain builder company CEOs will start, home robot factories will be arsoned and sabotaged etc. The Cosmists and Cyborgists will be forced to strengthen their resolve. The Artilect War will be drawing ever closer.

9.8. The Terrans Will "First Strike", Before Its Too Late For Them
The Terrans will have been organizing for a first strike and will have made preparations. They will then take power in a world wide coup of the global government that is likely to exist by mid century, and begin exterminating the Cosmists and Cyborgists in a global purge, exterminating millions of them, or at least that is the Terran plan.

9.9. Cosmists/Cyborgists Anticipate this First Strike and are Ready
But the Cosmists/Cyborgists will be following the arguments of the Terrans very closely, and will be preparing equally for a confrontation against the Terrans. They will have their own plans and their own weapons and militaries. If the Terrans strike first, a quick reply will follow from the Cosmists/Cyborgists, and the Artilect War will have begun.

9.10. Later 21st Century Weapons, Leads to Gigadeath War
If one extrapolates up the graph of the number of people killed in major wars from the early 19th century (the Napoleonic wars) to later 21st century (the Artilect War), then one predicts that *billions* of people will be killed, using later 21st century weapons. This

"gigadeath" figure is the characteristic number of deaths in any major later 21st century war. About 300 million people were killed for political reasons in the 20th century.

10. Vote

At the end of the talks I give on this topic, I usually invite my audiences to vote on the following question : *"Do you feel personally that humanity should build artilects, these godlike massively intelligent machines, despite the risk that they might decide, in a highly advanced form, to wipe out humanity? Yes or No."* The result is usually around a 50/50, 60/40, 40/60 Cosmist/Terran split. I noticed that most people, like me, are highly ambivalent about artilect building. They are awed by the prospect of what artilects could become, and horrified at the prospect of a gigadeath Artilect War. The fact that the Cosmist/Terran split is so even will make the Artilect War all the more divisive and bitter. This divisiveness can be expressed in the form of the following slogan : **Do we build gods, or do we build our potential exterminators?**

11. Questionnaires

This past year I have been handing out questionnaires on the issue of species dominance. The first one was given to a group of electronic engineers, in Melbourne, Australia. 60% of them thought that an Artilect War is coming. Even half of the members of the various "Transhumanist" organizations (who usually think that an Artilect War is improbable) think that the rise of artilects would pose an "existential risk" to human beings - so the future looks pretty gloomy.

12. Is the Artilect War Avoidable?

If an Artilect War, killing billions of people, occurs in the middle-late 21st century, then young people alive now will probably still be alive to be part of it, and therefore will probably be killed in it. This is such a depressing prospect, that it is understandable that much effort in the "Transhumanist" research community is devoted to trying to make artilects "human friendly." Some brain builders think that it may be possible to make artilects so that they remain friendly towards human

beings, even once they have modified themselves into vastly superior creatures.

Personally, I am extremely skeptical that this is possible. The early artilects, still a little bit dumber than their human programmers, could be made to be "human friendly", but once they start performing "evolutionary engineering" experiments on part of themselves, to vastly increase their mental capacities, there will be no way to ensure the "human friendly" outcome.

It is virtually certain, that advanced artilects will have attitudes towards human beings that will be totally alien to us. Humans will not be able to predict these attitudes, hence there would always be a risk that the artilects could turn out to be very "human unfriendly." Therefore Terran politicians will not tolerate the construction of superhuman artilects and in the limit, will go to war against the Cosmists/Cyborgists to stop the rise of the artilect.

Another approach to avoiding an Artilect War is to have *all* human beings become cyborgs. If this could be done "lock step", so that everyone advances at the same rate simultaneously (e.g. with everyone adding the same artilectual components to their heads at the same time) then the argument of the Cyborgists that *"an Artilect War could be avoided because there would be no Terrans nor Cosmists left to fight it"* would be valid – but it is an entirely unrealistic precondition.

In reality, there would be "cyborgian divergence." The cyborgs would advance in many different directions, and at different speeds. Many people would remain ardent Terrans, choosing not to modify themselves at all. To the Terrans, there is not much difference between an advanced cyborg and a pure artilect, given the huge computing capacity of nanoteched, one bit per atom, matter. The presence of millions of cyborgs in their midst would only render the Terrans even more paranoid and fearful.

The Terrans could not help noticing that the cyborgs and artilects keep getting smarter every year, so if the Terrans want human beings to remain the dominant species, the Terrans will have to "first strike" and prepare for it, before they become too stupid.

There are however scenarios where humanity escapes an Artilect War. For example, the artilects come into being far faster than anyone had anticipated, so that there is not enough time for human politics to react. Then the artilects quickly decide that their fate lies far from the earth, and into the cosmos. They simply leave, sparing humanity.

This is a possibility, but less likely than the scenario in which it takes decades to figure out how the human brain works, in order to put the principles of the functioning of the human brain into artificial brains, to reach human intelligence and consciousness levels in machines. Thus there will be enough time for human politics to unfold. The Terrans will have enough time to prepare for the Artilect War, and so will the Cosmists/Cyborgists, to defend themselves against the anticipated first strike of the Terrans.

In my view, the most realistic scenario is in fact the worst. I'm very glad to be old now (mid 60s). I will probably live for another 20-30 years, time enough to see the "Species Dominance Debate" rage, but not the Artilect War. I will be lucky enough to live between the two major wars – WW2 and the Artilect War. I will die peacefully in my bed - but the young generation will not. They will be caught up in the horror of gigadeath and will not survive it.

Prof. Dr. Hugo de Garis was formally Director of the Artificial Brain Lab, in the School of Information Science and Technology at Xiamen University, Xiamen, Fujian Province, China, where he was directing the building of China's first artificial brain. He is now an "ARCing" (after retirement careering) mathematical physicist, researching into the possibility of "femtotech" and topological quantum computing, etc.

He is the author of the books "The Artilect War : Cosmists vs. Terrans: A Bitter Controversy Concerning Whether Humanity Should Build Godlike Massively Intelligent Machines" "Multis and Monos: What the Multicultured Can Teach the Monocultured : Towards the Creation of a Global State" and is currently writing a third book "Artificial Brains : An Evolved Neural Net Approach." He has lived in 7 countries (Australia, England, Holland, Belgium, Japan, America, China.) He travels the world giving invited talks on the "Species

Dominance Debate" and writes essays on this and other topics. See his website http://profhugodegaris.wordpress.com

Prof de Garis was recently made the technical consultant for a major Hollywood movie on the broad theme of this essay.