Michael M. Fischer Untersiggenthal, 02.09.2019

Enlarged Board of Appeal

Attn.: Mr Wiek Crasborn

Sent by email to EBAamicuscuriae@epo.org

Re.: Amicus Curiae Brief concerning case G1/19

Dear Chairman and Members of the Enlarged Board of Appeal,

My name is Michael Fischer, I am a European Patent Attorney and have been dealing with computer-implemented inventions both in industry and private practice for almost 16 years. Incidentally, as a patent attorney trainee, I was involved in drafting the grounds of appeal in T 1265/09 which has awakened my interest in the patentability of computer-implemented simulations. I take the opportunity to present some arguments in the above-identified case. The opinion expressed in the following is my own:

Introduction, Examples and Scope of the Referral

Before dealing with the three questions that have been referred to the Enlarged Board of Appeal, I would like to approach the field of simulation from a broader perspective and introduce some nomenclature:

According to the Association of German Engineers, the term **simulation** means "the imitation of a system with its dynamic processes in an experimentable (open to experiments) model to obtain knowledge that can be transferred to reality"[1]. Beyond this definition coming from an engineering/technological context, the term simulation is also used for example in economic sciences. Correspondingly, a **simulated system or process** may be a technical system or process but may also be non-technical, such as an economic system, e.g. the simulation of a national economy or an economic cycle, or the simulation of a game of luck. A **computer-implemented simulation** makes use of a computer to perform the simulation, i.e. a computer is the **simulating system/ simulation system**. A simulation typically involves a **simulation model** which is often a mathematical model. Typically, simulation is used

[1] Translated from Guidelines of Association of German Engineers (VDI) No. 3633, paper 1

when a problem is too complex to be approached theoretically or by means of formulae. By contrast to computer-implemented simulations, there also exist **physical or real-world simulations** which are performed in the real-world e.g. in a laboratory under special conditions.

At paragraph 21 of T489/14, the referring Board discusses the scope of the term “simulation”. To illustrate the breadth of the field of computer-implemented simulations, I would like to present some examples which I have come across in my life as a patent attorney and as a student of computer science:

a) Ray Tracing: In the field of computer graphics, the term “ray tracing” denotes a method which is based on the simulation of paths of light rays to create a realistic 3D image.[2] This form of simulation is not followed by a subsequent manufacturing step. Its final purpose is the creation of a realistic computer image. Ray tracing is often used in computer games, which are themselves often considered to be simulations of the reality.

b) Artificial Intelligence: Artificial intelligence is considered as the simulation of human intelligence by a machine, particularly a computer[3]. Work that is currently still performed by a human being (e.g. drafting a legal opinion), will be performed by an AI system in the future.[4] A neural network can be considered as a high level simulation of the human brain. (At least, the development of neural networks has been inspired by the human brain.)

c) (Computer-Implemented) Wind Tunnel Simulations, (Computer-Implemented) Crash Test Simulations: These simulations are still performed in the real-world, but are increasingly performed as computer-implemented simulations using finite elements methods which have become commonplace in recent years, and are now the basis of a multibillion dollar per year industry.

d) Computer-implemented Climate Simulation: It uses quantitative methods to simulate the interactions of the important drivers of climate, including atmosphere, oceans, land surface and ice.

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[2] https://www.scratchapixel.com/lessons/3d-basic-rendering/ray-tracing-overview/light-transport-ray-tracing-whitted

[3] In a nutshell, the “Turing Test” defines that a machine is considered to be intelligent if a human evaluator could not distinguish its answers cannot be distinguished from those of a human being.

[4] https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence

e) Molecular Dynamics Simulation in Drug Design: Recent years have witnessed rapid developments of computer-aided drug design methods, which have reached accuracy that allows their routine practical applications in drug discovery. Computational methods have played pivotal role in drug discovery efforts for many years. Molecular dynamics simulation have been long proposed to provide insight into protein dynamics beyond that available crystallographically, and unravel novel cryptic binding sites, expanding the druggability of the targets. Molecular dynamics simulations are also used in the field of ligand binding and unbinding. Molecular dynamics simulations are also used to guide further optimization of the molecules stemming from in silico discovery campaigns. Development of several approved drugs including early examples of Saquinavir, Ritonavir, Indinavir (all three are important in the treatment of HIV), Captopril and Tirofiban has benefited substantially from the use of computer-aided drug design, in particular molecular dynamics simulation.[5]

f) Simulated Annealing: A probabilistic technique for approximating the global optimum of a given function. Specifically, it is a metaheuristic to approximate global optimization in a large search space for an optimization problem. The name and inspiration come from annealing in metallurgy, a technique involving heating and controlled cooling of a material to increase the size of its crystals and reduce their defects. Both are attributes of the material that depend on its thermodynamic free energy. Heating and cooling the material affects both the temperature and the thermodynamic free energy. The simulation of annealing can be used to find an approximation of a global minimum for a function with a large number of variables. It is actually a mathematical optimization method but heavily inspired by technical/physical considerations.[6]

g) Leaky Bucket Simulation: A method that is used in packet switched computer networks and telecommunications networks in both the traffic policing and traffic shaping of data transmissions, in the form of packets, to define limits on bandwidth and burstiness. It is based on a (technical) analogy of how a bucket with a leak will overflow if either the average rate at which water is poured in exceeds the rate at

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[5] Sledz, P. and Caflisch, Amedeo,"Protein structure-based drug design: from docking to molecular dynamics" in Current Opinion in Structural Biology, vol. 48, February 2018, p.93-102

[6] https://en.wikipedia.org/wiki/Simulated_annealing

which the bucket leaks or if more water than the capacity of the bucket is poured in all at once, and how the water leaks from the bucket at an (almost) constant rate.[7]

h) Brownian Motion Simulation: Brownian Motion is the random motion of particles suspended in a fluid resulting from their collision with the fast-moving molecules in the fluid. This simulation can be used to simulate stock prices.[8]

Thus, the Enlarged Board is well-advised to indicate how it defines the term "computer-implemented simulation" in its decision.

When applying the COMVIK approach (T 641/00), then it is clear that the simulating computer is considered to be technical. Also further aspects (e.g. special hardware architecture) of the simulating computer are considered to be technical. In such cases, it is irrelevant whether the simulated system or process is considered to be technical since technical features of the simulating computer may be enough to acknowledge the presence of an inventive step.

However, as explained above, technical aspects could also be present in features relating to the simulation model (see e.g. Simulated Annealing, Leaky Bucket, Brownian Motion). I would advocate that features of the simulation model that are inspired by technology should be considered as technical. In such cases, it is irrelevant whether the simulated system or process is considered to be technical since technical features of the simulation model may be enough to acknowledge the presence of an inventive step. It should be mentioned that the questions referred to the Enlarged Board leave aside the question of how to assess inventive step if a non-technical system is simulated by a simulation model that is inspired by technical considerations (e.g. simulation of stock prices by Brownian Motion) and do not deal with the question of how to assess inventive step if a non-technical system is simulated by a non-standard simulating computer either which has technical features that can support inventive step.

> **Question 1: In the assessment of inventive step, can the computer-implemented simulation of a technical system or process solve a technical problem by producing a technical effect which goes beyond**

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[7] https://en.wikipedia.org/wiki/Leaky_bucket

[8] Farida, A. et al., "Stock price prediction using geometric Brownian motion", Journal of Physics: Conference Series, vol. 974, conference 1, 2018

the simulation`s implementation on a computer, if the computer-implemented simulation is claimed as such?

<u>Interpretation</u>

Firstly, it is worthwhile mentioning that the use of the wording “as such” in Question 1 appears to be misleading. The term “as such” is used in Art. 52 (3) EPC and refers to the list of non-inventions defined in Art. 52(2) EPC. These are excluded from patentability if the European patent application or European patent relates to such subject-matter as such. For instance, a computer program is excluded from patentability if it does not bring about “a further technical effect” as stated in the headnote of T1173/97. It must be emphasized that this decision has nothing to do with the assessment of “inventive step”, contrary to Question 1. In other words, the wording “in the assessment of inventive step” is in contradiction with the wording “if the computer-implemented simulation is claimed as such”. In Question 1, however, it appears that the referring Board intended to say “if the computer-implemented simulation is claimed <u>without any final step of manufacturing, controlling, etc</u>.”. Confusingly, when reading T489/14 one could get the impression that both interpretations are the same in the opinion of the referring Board in the sense that a subsequent step of manufacturing or controlling is necessary to establish a link to the real-world without which a technical effect cannot be brought about. In the following, the term “as such” is interpreted in the sense of <u>“without any final step of manufacturing, controlling, etc”.</u> A reformulation of Question 1 could remove any unclarities.

Secondly, Question 1 is restricted to the simulation of <u>technical</u> systems or processes. That means that the corresponding real-world system or process that is simulated is technical by its nature. It should be assumed that technicality of features of a corresponding real-world system is <u>inherited</u> into the simulation. All features which would be considered technical in a corresponding real-world system (i.e. the system which is simulated) should be considered as technical in the simulation, while all non-technical features of the corresponding real-world system should be considered as non-technical in the simulation. This approach may be helpful in determining which features can contribute to inventive step in the framework of the COMVIK approach.

Real-World Simulation vs. Computer-Implemented Simulation

There is no doubt that a method to be performed in a real-world wind tunnel would in general be considered to be technical and all features would be considered in the assessment of inventive step. However, if the same method would be performed by means of a computer-implemented simulation, this would possibly not be the case according to the referring Board`s argumentation.

> "Wind tunnel experiments are always associated with high costs, mainly because of the high capital expenditure involved in the construction. Therefore, attempts are increasingly being made today to replace the experiments with computational fluid dynamics (CFD). The phenomena are already well reproduced today. However, the vision of replacing wind tunnel experiments with numerical simulation is still far from reality. This applies even more to aeroacoustic simulation (CAA, Computational Aeroacoustics)."[9]

A similar situation arises with (physical) car crash tests which are more and more performed as computer-implemented simulations:

> "A crash test almost always leads to the destruction of the examined vehicle - often even with expensive prototypes. If possible, these tests are therefore replaced by computer simulations (see finite element method). Sometimes no complete vehicles are used, but only relevant parts."[10]

As a third example, simulation of heat distribution on a workpiece is increasingly simulated by means of a computer. In other words, more and more (real-world) simulation methods are implemented *in silico*.

If an engineer develops a simulation method for a real-world wind tunnel, then he could get a patent for it, whereas if he tried to implement precisely the same method possibly with the help of a programmer experienced in numerical fluid simulation as a computer simulation, then this could possibly not be protected by a European patent because the features of the simulated system would not be considered to be

[9] translated from: https://de.wikipedia.org/wiki/Windkanal
[10] translated from: https://de.wikipedia.org/wiki/Crashtest

technical. But: a computer-implemented simulation has to reflect the physical reality as closely as possible and therefore, the technicality of real-world features is inherited into the simulation. If a simulation method could be performed in the real-world as well as in form of a computer-implemented simulation, then both deserve to be protected by a European patent. The technicality of features does not vanish only because they are implemented as a simulation *in silico,* nor does thereby change the field of technology. Who would have doubts that the field of technology of a real-world wind tunnel simulation is the same as that of a computer-implemented wind tunnel simulation?

"Direct Link with Physical Reality"

The referring Board repeatedly mentions the criterion "a technical effect requires, at a minimum, a direct link with physical reality" – I agree so far – but then it continues to say "…such as a change in or a measurement of a physical entity". It is in the very nature of a simulation of a technical system or process to try to reflect (all or a part of) the properties of the technical system or process as well as possible. For this reason alone, a computer-implemented simulation of a technical system or process inherently has a direct link with physical reality. Considering computer-implemented simulations as a subset of computer-implemented inventions, then it is not surprising that patent protection of the latter is subject to critical scrutiny and meets a lot of (political, legislative) resistance since some of these purported inventions are clearly not technical (i.e. finance software) and thus not eligible for patent protection. However, precisely the subset of computer-implemented simulations of technical systems or processes should be regarded with less critical scrutiny since it has a direct link with physical reality (simply because it simulates physical reality) and normally serves an "adequately defined technical purpose" (T1227/05). A simulation of a physical system or process of the real world should be considered to be technical since it has at least in principle the capability of solving a technical problem by producing a technical effect that goes beyond the implementation of the simulation on a computer. Computer-implemented simulations are tools that are nowadays used by engineers in which physical systems or processes are modeled in order to gain insights before the corresponding real system is produced in order to produce the following exemplary technical effects: confirming feasibility or functionality, avoiding dangerous situations, saving physical resources, or avoiding hazardous situations for humans. While I would say that the criterion of a “direct link with physical reality” is fulfilled by producing these technical effects, the referring Board appears to interpret this criterion in a narrower sense in that it clarifies that, for instance, “a change in or a measurement of a physical entity” is needed, which seems to be in contradiction with computer-implemented simulations. The purpose of a computer-implemented simulation is to construct something *in silico* and be able to study it. Certainly, the ultimate aim may be to build something in reality, but this is not part of the computer-implemented simulation method anymore and typically is pretty much conventional and does not require any inventive activity anymore since nowadays, for instance, 3D-printing allows to quickly bring the result of the computer-implemented simulation into physical reality. Claims that require a final step of manufacturing or controlling would be of limited value especially in times where simulation and production is increasingly separate and performed by different entities.

<u>Discussion of T1227/05</u>

I believe that T1227/05 provides clear guidance for dealing with computer-implemented simulations of technical systems or processes which has proven to be well applicable in practice. However, the referring Board seems to have two specific doubts regarding this decision:

“First, although a computer-implemented simulation of a circuit or environment is a tool that can perform a function “typical of modern engineering work” it assists the engineer only in the cognitive process of verifying the design of the circuit or environment, i.e. of studying the behavior of the virtual circuit or environment designed. The circuit or environment, when realised, may be a technical object, but the cognitive process of theoretically verifying its design appears to the fundamentally non-technical.

Second, the decision appears to rely on the greater of the computer-implemented method as an argument for finding technicality. But any algorithmically specified procedure that can be carried out mentally can be carried out more quickly if implemented on a computer, and it is not the case that the implementation of a non-technical method on a computer necessarily results in a process providing a technical contribution going beyond its computer implementation (see e.g. decision T 1670/07 of 11 July 2013, reasons 9).”

I think that the first doubt is unjustified simply because of the fact that the subject-matter underlying decision T1227/05 is directed to “a computer-implemented method”. For this sole reason, it cannot be a pure mental act anymore. An exclusion according to Art. 52(2) EPC is not possible since it is well established jurisprudence of the Boards of Appeal that one technical feature (here: “computer”) suffices to overcome the hurdle of Art. 52(2) EPC.

I think that the second doubt is also unjustified and might be based on a misunderstanding of T 1227/05 because this decision merely says that a higher speed can only be accepted as technical effect if it relates to a subject-matter that is considered to be technical by itself, which is the case in T 1227/05. At reason 3.2.5, it says: “a mere speed comparison is not a suitable criterion for distinguishing between technical and non-technical procedural steps”. In short, a faster computation of square root of “2” cannot be accepted as a technical effect because it is purely mathematical, whereas a faster way of compressing an image is acceptable[11], even if it is primarily based on a mathematical algorithm.

Basically, the difference between T 1227/05 and T 489/14 does not so much reside in the doubts mentioned above but boils down to the question of what is considered to be technical or not – one of the most fundamental questions in patent law. T1227/05 has a broader – and possibly more contemporary – understanding of technology than T489/14.

Following T1227/05, I think that all features of the claim that serve an “adequately defined technical purpose”[12] (of the claimed computer-implemented simulation method) should be taken into account in the assessment of inventive step in the framework of the COMVIK approach.

Evolution of the Definition of “Technology”

It would be a fatal sign for Europe`s digital agenda, if the EPO decided to deny patentability of computer-implemented simulations. On the one hand, real-world

[11] Following T 208/84, image processing is considered to be technical.
[12] In particular also mathematical features that serve an adequately defined technical purpose.

simulations would be privileged vis-à-vis computer-implemented simulations in that it is easier to get a European patent for the first in comparison to the latter. On the other hand, who would still want to apply for a patent for a real-world simulation method if it could be circumvented by a corresponding computer-implemented simulation? Knowing that the definition of “technology” would evolve over time, the fathers of the EPO did not provide a definition for it in the EPC. For instance, the term “4th industrial revolution”, which is frequently used today and which relates to recent development in which computer-implemented simulations play a crucial role, precisely indicates such a(n) (r)evolution of technology. It would be contraindicative if the Enlarged Board stuck to an old-fashioned notion of technology, even more so since T 1227/05 (and T 625/11) moved into a more forward-looking direction already 13 years ago. It is common ground that the future of technological development in the classical industries will lie in the field of digitalization. While in the past, the focus was on the creation of mechanical tools, the focus will be on digital tools (such as computer-implemented simulations) in the future. If the European patent system is unable to follow this evolution of “technology”, then it will become obsolete.

After all, Question 1 should be answered with “YES”. Following the rationale of T 1227/05, a computer-implemented simulation which is performed for an “adequately defined technical purpose” cannot be denied a technical effect.

> **Question 2: If the answer to the first question is yes, what are the relevant criteria for assessing whether a computer-implemented simulation claimed as such solves a technical problem? In particular, is it a sufficient condition that the simulation is based, at least in part, on technical principles underlying the simulated system or process?**

Question 2 should be answered with “YES”. The fact that the simulation is based, at least in part, on technical principles underlying the simulated system or process is indeed a sufficient condition. Alternatively, the criterion that the computer-implemented simulation serves “an adequately defined technical purpose” could be used.

> **Question 3: What are the answers to the first and second questions if the computer-implemented simulation is claimed as part of a design process, in particular for verifying a design?**

The answers to Questions 1 and 2 remain the same. However, any claimed step relating to a design process may provide an additional basis for a technical effect of the claimed subject-matter.

Conclusion

I think that a deviation from T 1227/05 and T 625/11 is not necessary and would cause legal uncertainty since new criteria may not be applicable to all cases in the vast and diverse field of "computer-implemented simulations" – a broad term which is difficult to define as explained at the outset. Therefore, the Enlarged Board of Appeal should endorse the decisions T 1227/05 and T 625/11 and rely on a further organic development of the jurisprudence in this field. Future individual decisions will show which computer-implemented simulations are considered to be technical or not.

I would be pleased if the Enlarged Board of Appeal took my deliberations into account in its decision.

Yours faithfully,

Michael Fischer