

Registry of the Enlarged Board of Appeal
Att: Mr Wiek Crasborn
European Patent Office
D-80298 Munich
Germany

DATE: August 30, 2019
OUR REF: 00058

By email: EBAamicuscuriae@epo.org

Case No. G 1/19 (Pedestrian simulation)

Dear Sirs,

Please find enclosed an amicus curiae brief concerning the above case which is submitted in the name of MAGMA Gießereitechnologie GmbH by Nordic Patent Service A/S of Denmark.

Yours faithfully,
Nordic Patent Service A/S
Association No. 338



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Written submission to the Enlarged Board of Appeal

This submission contains an *amicus curiae* brief to the Enlarged Board of Appeal of the European Patent Office on the subject of case G1/19: Referral under Art. 112(1)(a) EPC by the Technical Board of Appeal 3.5.07 to the Enlarged Board of Appeal.

The brief is submitted by Nordic Patent Service A/S, on behalf of our client MAGMA Gießereitechnologie GmbH, headquartered in Aachen, Germany.

MAGMA Gießereitechnologie GmbH is a developer and supplier of software solutions for simulating casting and molding processes. MAGMA's product and service portfolio includes simulation software MAGMASOFT and SIGMASOFT, as well as engineering services for casting and molding design and optimization. The software is used world-wide by foundries, molding plants, casting buyers, and designers, especially for the optimization of cast components in automotive and heavy industry applications, and for engineered plastic products. Worldwide, MAGMA employs more than 230 people in software development, support, marketing, and administration, and relies on their patent portfolio for protecting their core technology in different jurisdictions (Europe, US, China, Japan, and so on).

I. Inadmissibility

According to Art. 112(1) EPC, the Board of Appeal may only refer a question to the Enlarged Board of Appeal if the following conditions are met:

- (A) the question relates to ensuring uniform application of the law, or
- (B) to a point of law of fundamental importance, and
- (C) the Board of Appeal considers a decision to be required.

G1/19 (Pedestrian simulation) relates to patentability of computer-implemented simulations. This referral is advantageously compared to previous referral G3/08 (Programs for computers), in which referral all questions were rejected as inadmissible, though an opinion was given on all questions.

The issues given in questions 1 and 2 of the present referral were, though not decided upon, discussed to a large degree in the decision of G3/08. Since these issues were found to be dealt with uniformly by the Boards, the corresponding questions were found to be inadmissible. Case law subsequent to the G3/08 decision has also remained uniform, ensuring continued, uniform application of the law. Hence, there is no requirement for a decision, leaving at least neither condition (A) nor (C) of Art. 112(1) EPC fulfilled.

The questions referred to in G3/08 largely relate to a computer program, as well as the necessity for a further technical effect in order to avoid exclusion under Art. 52(2) EPC, and the definitions of such a further technical effect. Though the present referral relates mainly to Art. 56 EPC, the definitions of “computer program” and “further technical effect” are necessarily the same.

The opinion of G3/08 is clear on the issue that claims for a computer program and claims for a computer implemented method do not have an identical scope (see item 11.2). A method cannot be divorced from the device that it is to be carried out on, and there is a logical distinction between a method carried out by a computer and the sequential list of instructions, i.e. the computer program, which specifies that method. This is also confirmed by, e.g., T424/03, where it is emphasized that a method implemented in a computer system does not represent a sequence of computer-executable instructions (i.e. a computer program) which just have the potential of achieving such an effect when loaded into, and run on, a computer, but represents a sequence of steps actually performed and achieving an effect.

Additionally, G3/08 states, in item 10.13, that a claim in the area of computer programs can avoid exclusion under Articles 52(2)(c) and (3) EPC merely by explicitly mentioning the use of a computer or a computer-readable storage medium, but also that a claim which specifies no more than "Program X on a computer-readable storage medium," or "A method of operating a computer according to program X," will always still fail to be patentable for lack of an inventive step under Articles 52(1) and 56 EPC.

It is not clear what is intended by question 1 of G1/19, when referring to a “computer-implemented simulation claimed as such”. Not only G3/08 distinguishes between computer

programs and computer implemented methods, but so does the patent application forming the basis for the present referral. In fact, T0489/14 distinguishes between a “computer-implemented method”, a “computer program”, a “mathematical model”, and an “algorithm for simulating”.

Due to the actual mention of “computer”, it is a reasonable conclusion that “computer-implemented simulation” corresponds to either a “computer program” or a “computer-implemented method”.

One could consider “computer-implemented simulation” to correspond to “computer-implemented method”, as suggested, e.g., in item 19 of the present referral. G3/08 clearly states that a claim in the area of computer programs can avoid exclusion under Articles 52(2)(c) and (3) EPC merely by explicitly mentioning the use of a computer or a computer-readable storage medium, and that a claim which specifies no more than a method of operating a computer according to program X" will always fail to be patentable for lack of an inventive step under Articles 52(1) and 56 EPC.

Additionally, case law subsequent to G3/08 and relating to “computer-implemented methods” has been uniform in its application (see T1265/09, T1630/11, T988/12), and question 1 should therefore be found inadmissible.

Nevertheless, referral G1/19 also discusses “programs for computers as such” as well as “technical considerations on the part of the programmer” (see e.g. items 23 and 34). It would not be unreasonable to assume that the “computer-implemented simulation” referred to in G1/19 corresponds to a “computer program”, and that question 1 therefore relates to a “computer program as such”.

As mentioned above, G3/08 was clear on computer program claims avoiding exclusion under Articles 52(2)(c) and (3) EPC by explicitly mentioning the use of a computer or a computer-readable storage medium, but that such claims could fail to be patentable for lack of an inventive step.

Furthermore, case law subsequent to G3/08 and relating to “computer programs as such” has been uniform in its application, stating that computer programs as such may, or may not, have the potential to produce a further technical effect and hence have technical character (see e.g. T1351/04, T1670/07). Claims relating to “computer programs as such” have therefore also been dealt with uniformly by the Boards of Appeal, and question 1 should therefore be found inadmissible in view of this interpretation of “computer-implemented simulation” as well.

Correspondingly, question 2 of G1/19 relates to the relevant criteria for assessing whether a “computer-implemented simulation as such” produces a technical effect beyond the implementation on a computer. The issue of further technical effect was sufficiently discussed in G3/08, in particular in view of the statement that a claim which specifies no more than a method of operating a computer according to program X will always fail to be patentable for lack of an inventive step, rendering question 2 inadmissible.

Furthermore, since questions 2 and 3 both depend on question 1, questions 2 and 3 should be found inadmissible for this reason as well.

As stated in T154/04, although questions may concern important and relevant points of law, such points of law do not warrant a referral to the Enlarged Board of Appeal when the Boards seemingly have no doubts how to answer the questions on the basis of the Convention and the established case law. Since this is the case here, as is clear from the discussion above, the points of fundamentally important law given at least in questions 1 and 2 of G1/19, do not need to be decided upon further. Hence, condition (B) of Art. 112(1) EPC is also unfulfilled, and questions 1 to 3 should be found inadmissible for this reason as well.

Additionally, question 2 is not of a legal nature but a factual one. Question 2 is a technical question relating to the technical principles underlying a simulated system or process, which question can only be answered while taking into account the circumstances of the specific case.

As is clear from T118/89 and T181/82, factual questions should not be referred to the Enlarged Board of Appeal. The requested referral in T118/89 concerned amendments by generalization or deletion of features, a question which was considered to be factual and not legal and therefore refused by the Board. In T181/82, the requested referral was concerned with whether the person skilled in the art can understand the technical content of prior art. The requested referral was refused by the Board since it was a primarily technical question requiring the skilled person to interpret technical information.

Hence, question 2 should be found inadmissible for this reason as well.

Consequently, none of the conditions of Art 112(1) are met, and the referral should be found inadmissible in its entirety.

II. Development of innovation

Thanks to the advancement of manufacturing technologies, manufacturers of electronic equipment, consumer goods, medical equipment, and automotive parts produce a vast amount of different products requiring cast metal and injection molded plastic components on a large scale.

In the metal casting industry, the key challenge is not only to improve casting yield to meet these increasing demands, but also the minimization of defects, and increasing strength and fatigue performance of cast products to meet increasing quality requirements. In order to overcome these challenges, most of the foundries around the world by now have adapted a simulation-based casting methodology. Simulation-based casting involves computer-aided modelling of the part to be cast, pattern design, process simulation, and optimization. The analysis of the entire casting process and its optimization in a virtual domain has replaced the conventional trial and error approach by a more scientific proof-of-concept approach for producing high quality cast products. Defect prediction and minimization through simulations have become much easier with the advancement of simulation methods, resulting in high quality and repeatability of the cast products. Also, casting simulations

enable to produce these higher quality parts at a much faster rate with reduced production costs.

At the same time, competitive pressures are also driving manufacturers in the plastic injection molding industry to find new methods to optimize their designs in order to better match the designs to the production process. When the need for component or mold configuration modifications are discovered late in the design development process, the delay and associated costs to implement the necessary changes are significantly higher than in earlier stages of the design development stages. Thus, companies that want to ensure that their components are producible and will perform optimally would like to use computer aided engineering techniques to simulate or model the complex flows and process physics in an injection mold, in order to understand better the manufacturing process and integrate this knowledge into component design, early in the design phase.

The key challenge is that a true 3-D simulation of an injection molding process or a metal casting process involves a system of up to several hundreds of thousands of equations. In recent years, thanks in part to the predictable legal environment of protecting simulation related inventions through patents, lots of progress has been made to improve the efficiency of the simulation methods to cope with these complex calculations.

Nowadays, with optimized software and the processing power of modern workstations such simulations can be performed in a workplace, i.e. the results are obtained fast enough to be suitable outside the purely scientific research area and can be applied by engineers as an engineering tool in research and development departments, foundries and manufacturing plants of injection molded articles.

III. Practical simulation examples

A) EP3473351A1 - Method for controlling core shooting apparatus

Sand cores are widely used in a variety of casting processes for the production of metal cast parts using diverse metal alloy types for a wide range of applications, wherein sand cores

represent inner hollow structures of castings. Basic requirements of sand cores relate to both mechanical strength, dimensional accuracy and chemical stability. The production of sand cores by using so called core shooting machines is widely used in industrial practice. Core shooting is a highly complex process that is characterized by a coupled flow of air and sand, wherein the process is traditionally controlled by applying trial and error until the process works for a particular core box linked to the machine. The process in practice has a number of uncertainties leading to a variable sand core quality. In state-of-the-art machines there is actually no dynamic machine control available that may be able to readjust the process pressure and other process conditions in accordance to variable process conditions in real time.

By providing a core shooting machine with a computing device configured to simulate the core shooting process in real time, it becomes possible to provide a recommendation for any of the adjustable settings/process conditions of the core shooting machine. This allows for automatic adjusting of the core shooting machine to changing conditions before the quality of the produced cores deteriorates to an unacceptable level. Consequently, the quality of the produced cores can be maintained at a stable high level and time is saved that is otherwise used to empiric (trial and error) adjustment of the adjustable setting/process conditions.

B) US10140391B2 - Method of ray tracing for use in a simulation or calculation process
This invention relates to a method of simulating the influence of thermally coupled surface radiation, specifically in relation to casting processes. In particular, an unconventional simulation method is proposed by means of defining parallel computing steps on a computer comprising multiple processors to accelerate a ray tracing calculation, wherein some method steps are defined as abstract mathematical steps linked to physical entities of the computer (processors) to balance load and reduce communication costs between the processors. As such, the technical effect produced is an improvement of the simulation itself, and indirectly achieving savings in terms of computer time and computer memory.

C) EP2427835B1 - Simulation of ejection after mold filling
This invention relates to a method of simulating injection molding or metal casting processes that involve the filling of a cavity, cooling in combination with phase transformation and

solidification, and the subsequent removal of a finished part from the cavity. Design and development engineers have previously not been able to make accurate predictions of the characteristics of the product developed without actual test runs on the work floor. The simulation method provides a tool for engineers that allows the effects of both filling a mold, cooling of the part, and ejecting the part from the cavity to be included in the computation of the resulting stresses, warpage and deformations of the part.

D) EP2164694B1 - Method for describing the statistical orientation distribution of particles in a simulation of a mold filling process

This invention relates to a simulation of a process wherein a mold cavity is filled with a suspension that contains a large number of non-spherical particles such as fibers. The method and apparatus may be applied to the analysis of an injection molding process for producing a fiber reinforced molded polymer component or of a metal casting process for producing a fiber reinforced metal product. The orientation of the fibers in the final product is critical for the strength and stability of the final product, since such fibers can resist load only in the form of tension, and not in the form of shear or compression. With optimized software and the processing power of modern workstations such simulations can be performed in a workplace, i.e. the results are obtained fast enough to be suitable outside the purely scientific research area and can be applied by engineers in research and development departments, foundries and manufacturers of injection molded articles.

IV. Discussion of the referred questions

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

According to G3/08, case law has developed consistently in that a “method of operating a computer according to program X” will fail for lack of inventive step. Question 2b of G3/08 asked if a further technical effect is necessary to avoid exclusion, said effect going beyond those effects inherent in the use of a computer or data storage medium to respectively

execute or store a computer program. G3/08 further mentions that a technical effect in the form of different electrical currents is not sufficient to confer a technical character.

The case underlying referral G1/19, T0489/14, relates to a, comparatively speaking, technically non-complex solution. T1358/09, in which it is stated that whether two text documents in respect of their textual content belong to the same "class" of documents is not a technical issue, see item 5.2, also relates to such a technically non-complex solution.

However, far from all simulations or simulation methods are this simple. As stated in T1227/05, see item 3.2.2, "Without technical support, advance testing of a complex circuit and/or qualified selection from many designs would not be possible, or at least not in reasonable time. Thus computer-implemented simulation methods for virtual trials are a practical and practice-oriented part of the electrical engineer's toolkit. What makes them so important is that as a rule there is no purely mathematical, theoretical or mental method that would provide complete and/or fast prediction of circuit performance under noise influences." Simulation of pedestrian movement, as in T0489/14, requires far fewer technical considerations than, e.g., simulation of the performance of a circuit as in T1227/05.

According to T1358/09, the skilled person, using only his common general knowledge, would have had no difficulty in implementing the various steps of the simulation in question on a computer. However, in a complex simulation, the skilled person would not be a programmer, who receives instructions from an R&D group, translates this into suitable simulation language, and stores these instructions onto a computer or storage medium. Instead, the skilled person would necessarily have to be a team of experts providing said instructions, said experts being e.g. engineers acting within the different technical fields necessary for the simulation.

Clearly, there are simulation methods that simply cannot be performed by purely mental or mathematical means, and it seems highly unreasonable to, when attempting to ensure uniform application of the law, or discussing a point of law of fundamental importance, have

non-complex simulations as the starting point. Several examples of such highly complex simulations are given below.

A) Virtual trials

Without computer-implemented simulation methods, advance testing of a complex process, such as metal casting or injection molding, and/or qualified selection from many designs would not be possible, or at least not in reasonable time. In addition, without employing virtual simulations of such processes, development of cast products would practically require a huge number of molds to be produced in an iterative process before starting the actual manufacturing, which would clearly be a waste of both time and resources.

Thus, computer-implemented simulation methods for virtual trials are a practical and practice-oriented part of the engineer's toolkit.

B) Combination of technical fields

Simulations even more complex than the one referred to in T1227/05 could include making considerations relating to several technical processes in several technical fields. As an example, a simulation method could comprise considering conditions, requirements, and data relating to such diverse processes as: correctly filling a mold with a material (e.g. calculating energy, flow, temperature), cooling and packing of a material (considerations for cooling at an appropriate speed), ejection of a product from a mold (calculating ejection forces, location of ejector pins, deformation, stresses, and warpage of both mold and product), and verification of the product (mechanical resistance and stability, resilience). See e.g. Example C) wherein the simulation method of an injection molding or metal casting process provides a tool for engineers that allows the effects of both filling a mold, cooling of the part, and ejecting the part from the cavity to be included in the computation of the resulting stresses, warpage and deformations of a finished part. Without taking all of these considerations into account, no accurate results of the simulation method can be achieved.

C) Time constraints

These arguments are all in support of the argument that complex simulations produce a

technical effect because their design was motivated by technical considerations of the internal functioning of the computer, i.e. they concern algorithms particularly suitable for being performed on a computer.

C1) Real-time simulations (short time frame constraint)

In the case of real-time simulations running e.g. in self-driving cars, the time to take decisions to avoid an obstacle or accident is so short that performing multiple different simulation runs and comparing the outcomes to make an optimal decision would be impossible in the given time frame if done as a mental act by a skilled person (or a team) or without the specifically defined simulation steps which commonly include task-oriented simplifications of input data (filtering, compression) and an optimized model of the simulated system or process. This in itself should be sufficient to produce a technical effect solving a technical problem (avoiding obstacles or accidents).

In addition, the results in these cases are not aimed to support the mental decision of a human but in many cases to directly affect the system (vehicle comprising the computer that runs the simulation) – but these additional steps shouldn't be included in the claims for the simulation method itself.

For another industrial example to consider, see Example A) under headline *IV. Practical simulation examples*, wherein a computing device linked to a core shooting machine is configured to simulate a core shooting process of producing sand cores in real time, which allows adjusting of the core shooting machine to changing conditions before the quality of the produced cores deteriorates to an unacceptable level. In this exemplary simulation method, a core aspect is the determination of the transient process conditions in real time (wherein the time for a simulation run is shorter than the production cycle time) which enable the adjustment of process conditions between one production cycle and the next.

C2) Trial runs (shorter or equal time as real-world process)

Defining the working of a complex, real-world system in a sequence of simulation method steps based on clear, simplified rules of interactions provides a technical effect of actually

making it possible to run on a computer, considering the technical aspects (hardware elements and their combined performance) of the computer itself, in a shorter or at least similar amount/scale of time than it takes for the real world process. This is a key aspect of a simulation and one that provides all the discussed further effects (savings on time and costs, running multiple trials, etc.), and the technical effect (enabling the testing of concepts in an artificial environment with a given time constraint) is produced by the definition of the real-world systems or processes as simplified steps that are usually non-technical or abstract mathematical in nature, and which steps are usually the distinguishing features of an invention from the prior art and therefore the concern of assessment of inventive step.

C3) Possibility as mental act (lifetime constraint)

A second point to the above – if a simulation is so complex that it could not be realistically performed as a mental act in a human mind (or in a collective mind of a team) in a whole lifetime (which can be calculated based on processing capacity of the brain and average life expectancy), it makes the simulation method essentially impossible to perform as a mental process, thus the simulation's implementation on a computer produces the technical effect of enabling the calculation of simulation results at all.

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?*

In T1227/05 it was concluded that circulation of a circuit subject to $1/f$ noise constitutes an adequately defined technical purpose for a computer-implemented method functionally limited to that purpose. T1227/05 also states that computer-implemented simulation methods are themselves to be regarded as modern technical methods and that such simulation methods cannot be denied a technical effect merely on the ground that they do not incorporate a physical end product.

This is very much supported by the fact that, when assessing technical principles underlying a simulated system or process, and especially when referring continuously to “laws of

physics”, one must also take into account the physical paradox. A physical paradox is an apparent contradiction in physical descriptions of the universe. While many physical paradoxes have accepted resolutions, others defy resolution and may indicate flaws in theory. When, as in fields such as quantum physics and relativity theory, existing assumptions about reality have been shown to break down, this has usually been dealt with by changing our understanding of reality to a new one which remains self-consistent in the presence of the new evidence.

Thus, defining any criteria based in technical principles underlying a simulated system or process may prove to be an impossibly complex task (what principles should we accept?) or lead to incorrect assessment of an invention once the underlying principles are disproven. For example, if one were to simulate a quantum mechanical process or system, should we define the same technical principles as assessment criteria as for simulating a system based on our “everyday” laws of physics that apply to our perceived reality? What about a system based on the principles of gravitational singularity?

Additionally, we need to make a distinction between two types of simulations when talking about computer-implemented simulation methods. The first type of simulations simulate a system or process based solely on observed laws of physics defined in rules that are either generally known in the technical field or clearly defined in an application, thereby making sure that for the same model and same input parameters the simulation will produce the exact same outcome with each run. Such simulation methods, in our opinion, should always be assessed as fulfilling the criteria of solving a technical problem.

On the other hand, when a simulation involves a certain degree of uncertainty (produces different outcomes for the same model and same input parameters) further assessment may be necessary. The case underlying referral G1/19, T0489/14, constitutes one example of such a simulation process, since the human mind, i.e. the science of psychology, plays a role in the outcome of the simulation and, hence, requires further consideration.

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?*

In view of the discussions relating to questions 1 and 2, the limitation of the simulation being part of a design process has no influence at all on the assessment of inventive step.

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