

FOOD CONTAINER AND DEVICES AND METHODS FOR ATTRACTING ENHANCED ATTENTION

Technical Field

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In one aspect, the present invention relates to a food container suitable for both liquid and solid food products.

In another aspect, the present invention relates to devices and methods for attracting enhanced attention. More specifically, the present invention relates to
10 beacons for sustaining enhanced interest/attention, as well as to beacons with symbolic importance.

Background of the Invention

15 a) Food Container

The packaging industry is well developed throughout the industrialised world and is subject to general norms and practices. On the whole, in the case of food or beverage packaging, this needs to be able to hold food or beverages in a
20 food safe and hygienic condition, and to withstand storage and transportation; specifically to provide physical and barrier protection to the contents, to prevent contamination and agglomeration, to provide security including tamper control, and to be convenient. In recent years, there have been moves to reduce the amount of packaging material used and also to focus on more environmentally friendly
25 packaging, such as by use of recyclable and biodegradable materials. Lightweighting is a concept that has been prevalent in the industry for some time, which aims to reduce the amount of packaging material utilised, its weight and also the energy required for its manufacture.

In the case of packaging for liquid or other flowable materials, it is common
30 to use bottles, cans, cartons, bags and the like. Generally, such packaging has either a generally cylindrical form, such as a drinks can or bottle, or a cuboidal form, such as milk or juice cartons of the type commonly sold under the Elopak™

or Tetra Pak™ brands. This packaging is typically constituted by a smooth walled structure, often of multi-layered form, which minimises surface area and optimises the usable volume of the packaging. The contents of the packaging are often relied upon to maintain the form and integrity of the packaging, particularly during transportation and storage. For instance, a beverage container will often rely on the pressure of the beverage within the container to keep the container in its original shape. This enables the walls of the container to be made very thin, to the point that often once the container has been opened the walls become flimsy and are easy to collapse.

Food products are often sold in multiple units, such as cans and bottles, in which case it is common to tie these together with additional packaging, such as a sleeve, ring or yoke. This additional packaging also serves to stop individual packages from falling loose during transportation or storage, thereby reducing spoilage. However, such additional packaging adds further cost, both monetary and environmental.

The smooth nature of such packaging reduces a person's grip and it is not uncommon, particularly for large packages, for a person to struggle to handle the package without squashing it and causing spillage of the contents. This is particularly the case with large plastics drinks bottles.

DE 10004386 discloses a container for food or drinks with a cylindrical container having walls shaped to allow interlocking of a plurality of such containers.

b) Devices and Methods for Attracting Enhanced Attention

In the prior art, signal indicators and beacons are typically based upon color, brightness, periodic flashing frequency, rotational pattern, and motion, but not fractal dimension.

WO 95/17854 discloses a trophotropic response system comprising: a control module for providing a visual signal and an aural signal, wherein the aural signal includes at least a digitally generated ocean signal component and a binaural beat signal component; an audio unit for receiving the aural signal from

the control module; and a visual unit for receiving the visual signal from the control module wherein the visual signal is provided having a frequency corresponding to the frequency of the binaural beat signal component of the aural signal.

Both cognitive studies and simulations of the brain's limbo-thalamocortical system via artificial neural nets have shown that original ideas produced within the brain's stream of consciousness occur at a specific rhythm, typically near 4 hertz and a fractal dimension of approximately $\frac{1}{2}$ (see Literature References below: Thaler, 1997b, 2013, 2014, 2016a, b, 2017b). An interval of 300 ms (~ 4 Hz) has been referred to as the "speed of thought" (Tovée 1994).

In the referenced body of theoretical work of Thaler, the brain's thalamic reticular nucleus (TRN) is modeled as a constantly adapting auto-associative neural net (i.e., an anomaly or novelty detector), for which such ideational rhythms are the most noticeable due to their sporadic and unpredictable nature. Essentially, neural activation patterns within the cortex are thought to emit a telltale 'beacon' to the thalamus when they are generated within a stream having the above said frequency and fractal signature. Furthermore, these sporadic cognitive streams generally correspond to novel pattern formation and are considered the signature of inventive ideation.

It was also shown (Thaler 2016a) that the TRN's behavior as an anomaly detector was linked to creative thinking and enhanced attention in forming useful ideational patterns as stated in the following passage: "In the former case, creative achievements are the result of convergent thinking processes, requiring the attention of critic nets on the lookout for sporadic activations within the cortex that signal the formation of novel and potentially useful ideational patterns [3]. With non-linear stimulus streams present in the external environment (i.e., sporadic events such as the two audible clicks used in EEG studies to measure so-called P50 response), the attention of critic nets selectively shifts to these sporadic external event streams [3,14] dominating within cortex, rather than mining the weaker, internally seeded stream of consciousness for seminal thought."

In another publication (Thaler 2016b), frequency and fractal dimension were shown to be indicative of the relation between attention, ideation novelty, and such thought-process characteristics: "The search for a suitable affordance to guide

such attention has revealed that the rhythm of pattern generation by synaptically perturbed neural nets is a quantitative indicator of the novelty of their conceptual output, that cadence in turn characterized by a frequency and a corresponding temporal clustering that is discernible through fractal dimension.”

5 Regarding human response to light modulation, the Color Usage Lab of the NASA Ames Research Center published related information dealing with “Blinking, Flashing, and Temporal Response” (https://colorusage.arc.nasa.gov/flashing_2.php), stating the following: “The rate of flashing has a powerful influence on the salience of flashing elements. The human
10 eye is most sensitive to frequencies of 4-8 Hz (cycles/second). Very slow and very fast blinking are less attention-demanding than rates near that peak.”

A proposed approach based on the effects of fractal flickering of light stimuli was previously published (Zueva 2013). Fractal flickering exhibits scale invariance with time on the evoked responses of the retina and visual cortex in normal and
15 neurodegenerative disorders. In the proposed approach, standard stimuli are presented to patients who adapt to a flickering background with “specific chaotic interval variabilities between flashes (dynamic light fractal).” It was hypothesized that such an approach could be applied to facilitate adaptation to non-linear flickering with fractal dimensions in electrophysiological diagnostics.

20 Finally, in an article (Williams 2017) entitled, “Why Fractals Are So Soothing,” related to fractal patterns in the paintings of Jackson Pollock, the physiological response to viewing images with fractal geometries having a fractal dimension of between 1.3 and 1.5 was suggested to be an “economical” means for the eye-tracking mechanism of the human visual system to simplify processing
25 image content.

The ability to exploit fractal flickering for visual evoked responses (as in the approach described in Zueva 2013), or to detect a visually fractal image (as in the studies in Williams 2017) relate to visual and image processing.

It would be desirable to have devices and methods for attracting enhanced
30 attention. Such devices and methods would, *inter alia*, provide unique advantages over the prior art mentioned above.

Summary of the Present Invention

a) Food Container

5 This aspect of the present invention seeks to provide an improved container for food products. The invention is particularly suitable for, but not limited to, containers for liquids, such as beverages, and other flowable products.

 According to an aspect of the present invention, there is provided a food or beverage container comprising:

10 a generally cylindrical wall defining an internal chamber of the container, the wall having interior and exterior surfaces and being of uniform thickness;

 a top and a base either end of the generally cylindrical wall;

 wherein the wall has a fractal profile with corresponding convex and concave fractal elements on corresponding ones of the interior and exterior
15 surfaces;

 wherein the convex and concave fractal elements form pits and bulges in the profile of the wall;

 wherein the wall of the container is flexible, permitting flexing of the fractal profile thereof;

20 the fractal profile of the wall permits coupling by inter-engagement of a plurality of said containers together; and the flexibility of the wall permits disengagement of said or any coupling of a plurality of said containers.

 The present invention provides a food or beverage container having a container wall of different form than known in the art. The form taught herein
25 provides a number of practical advantages over known packaging products.

 Preferably, at least some of said pits and bulges have heads of a greater width than bases thereof.

 The feature of the fractal profile of the wall permits coupling by inter-engagement of a plurality of said containers together. This feature can provide a
30 number of practical advantages, including being able to do away with separate and additional tie elements to hold together a plurality of containers, as is necessary with currently available packages that rely on sleeves or yokes.

The flexibility of the wall permits disengagement of containers coupled together, by appropriate squashing of one or more of the containers to alter the fractal shape of the containers at the point of inter-engagement.

Advantageously, the corresponding convex and concave fractal elements
5 provide for increased surface area of both the interior and exterior surfaces of the container relative to a volume of the chamber. An increased surface area can assist in the transfer of heat into and out of the container, for example for heating or cooling the contents thereof.

The container wall may be formed of metal, plastics, elastomeric material or
10 glass. It may also be made from flexible or potentially flexible food products.

The fractal form of the container wall can also contribute to improved holding of the container, whereas known packages with a smooth surface can be slippery particularly when wet such as when condensation forms on the outside as a result of the contents being cold.

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b) Devices and Methods for Attracting Enhanced Attention

This aspect of the present invention seeks to provide devices and methods for attracting enhanced attention.

20 It is noted that the term “exemplary” is used herein to refer to examples of embodiments and/or implementations, and is not meant to necessarily convey a more-desirable use-case. Similarly, the terms “alternative” and “alternatively” are used herein to refer to an example out of an assortment of contemplated
25 embodiments and/or implementations, and is not meant to necessarily convey a more-desirable use-case. Therefore, it is understood from the above that “exemplary” and “alternative” may be applied herein to multiple embodiments and/or implementations. Various combinations of such alternative and/or exemplary embodiments are also contemplated herein.

Embodiments of the present invention provide a method for producing and
30 providing a pulse train to an LED or lamp at a frequency and fractal dimension that is highly noticeable to humans, being the same rhythm with which original ideas are formed and recognized in both the brain and advanced Creativity Machines. A

light source driven in such a manner may serve as an emergency beacon within environments filled with distracting light sources that are flickering randomly or periodically. Ease of detection may be improved using auto-associative neural nets as anomaly detectors within a machine-vision algorithm.

5 Thus, using TRN behavior as an anomaly filter in sustained creative activity and mental focus as detailed above in the context of the works of Thaler, the present invention exploits such a concept by embodying the same requisite characteristics (i.e., frequency and fractal dimension) in a signaling device in order to trigger the brain's innate ability to filter sensory information by "highlighting"

10 certain portions in order to make those portions more noticeable to the brain.

 That is, a single light-emitting element flashing at such a prescribed frequency is highly noticeable when viewed through anomaly detectors built from artificial neural networks. The sporadic nature of such pulse streams defeats the anomaly filter's ability to both learn and anticipate their rhythm, making said light

15 pulses visible as anomalies. Additionally, in contrast to pulse trains, having fractal dimensions less than $\frac{1}{2}$, the prescribed rhythms have sufficient frequency to catch the attention of a roving attention window, as when humans are shifting their attention across widely separated portions of a scene. If the detection system can calculate the fractal dimension of the anomalous light sources within the filtered

20 scene, the "neural flame" may be used as an emergency beacon that discriminates itself from other alternating light sources within the environment.

 Even to the naked eye, and without the use of an anomaly detector, fractal dimension $\frac{1}{2}$ pulse streams preferentially attract the attention of human test subjects. The most attention-grabbing aspect of such streams is that the 'holes' or

25 lacunarity between pulses occur as anomalies in what would otherwise be a linear stream of events. In other words, the pattern is frequently broken, such anomalous behavior possibly being detected by the TRN within the human brain as inconsistencies in the established arrival trend of visual stimuli. In contrast, should fractal dimension drop significantly below $\frac{1}{2}$, the frequency of anomalous pulses

30 drops, making them less noticeable to humans should either attention or gaze be wandering.

The incorporation of a “fractal rhythm” into a signal beacon, having a spatial fractal dimension near zero and a temporal delivery of a fractal dimension near $\frac{1}{2}$, relates to exploiting the understanding of TRN behavior, thereby avoiding aspects of visual and image processing as contributing elements.

5 Embodiments of the present invention further provide a symbol celebrating the unique tempo by which creative cognition occurs. The algorithmically-driven neural flame may be incorporated within one or more structures that resemble candles or altar fixtures, for instance, to accentuate the light’s spiritual significance. It is noted that that the light source or beacon can incorporate any
10 type of light-emitting device.

 Such embodiments stem from the notion of one perceiving neural net monitoring another imagining net, the so-called “Creativity Machine Paradigm” (Thaler 2013), which has been proposed as the basis of an “adjunct” religion wherein cosmic consciousness, tantamount to a deity, spontaneously forms as
15 regions of space topologically pinch off from one another to form similar ideating and perceiving pairs, each consisting of mere inorganic matter and energy. Ironically, this very neural paradigm has itself proposed an alternative use for such a flicker rate, namely a religious object that integrates features of more traditional spiritual symbols such as candles and torches.

20 Moreover, in a theory of how cosmic consciousness may form from inorganic matter and energy (Thaler, 1997a, 2010, 2017), the same attentional beacons may be at work between different regions of spacetime. Thus, neuron-like, flashing elements may be used as philosophical, spiritual, or religious symbols, especially when mounted atop candle- or torch-like fixtures, celebrating
25 what may be considered deified cosmic consciousness. Such a light source may also serve as a beacon to that very cosmic consciousness most likely operating via the same neuronal signaling mechanism.

 Therefore, according to aspects of the present invention, there is provided for the first time a device for attracting enhanced attention, the device comprising:

30 (a) an input signal of a lacunar pulse train having characteristics of a pulse frequency of approximately four Hertz and a pulse-train fractal dimension of approximately one-half generated from a random walk over successive 300

millisecond intervals, each step being of equal magnitude and representative of a pulse train satisfying a fractal dimension equation of $\ln(\text{number of intercepts of a neuron's net input with a firing threshold})/\ln(\text{the total number of 300 ms intervals sampled})$; and

- 5 (b) at least one controllable light source configured to be pulsatingly operated by said input signal;

wherein a neural flame is emitted from said at least one controllable light source as a result of said lacunar pulse train.

- According to another aspect of the present invention, there is provided for
10 the first time a device for attracting enhanced attention, the device including: (a) an input signal of a lacunar pulse train having characteristics of a pulse frequency of approximately four Hertz and a pulse-train fractal dimension of approximately one-half; and (b) at least one controllable light source configured to be pulsatingly operated by the input signal; wherein a neural flame emitted from at least one
15 controllable light source as a result of the lacunar pulse train is adapted to serve as a uniquely-identifiable signal beacon over potentially-competing attention sources by selectively triggering human or artificial anomaly-detection filters, thereby attracting enhanced attention.

- Preferably, the device further includes: (c) a processor for supplying the
20 input signal of the lacunar pulse train having the characteristics; and (d) a digital-to-analog (D/A) converter for transmitting the input signal to at least one controllable light source.

- Advantageously, the D/A converter is an onboard module of the processor, and wherein the module is embodied in at least one form selected from the group
25 consisting of: hardware, software, and firmware.

Preferably, the processor includes a thresholding unit for monitoring a random-walk trace for trace-axis crossings of a firing threshold of the thresholding unit, and wherein the trace-axis crossings result in activation transitions to generate pulse-activation sequences of the lacunar pulse train.

- 30 Advantageously, candidates of the pulse-activation sequences are filtered based on a zero-set dimension, and wherein the candidates are filled into a buffer of selected sequences having a fractal dimension of approximately one-half.

Preferably, filtered patterns are randomly withdrawn from the selected sequences in the buffer, and wherein the filtered patterns are configured to serve as the input signal to the D/A converter for transmitting to at least one controllable light source.

5 Advantageously, the filtered patterns are generated onboard the processor.

The uniquely-identifiable signal beacon can reduce distraction by providing a preferential alert over the potentially-competing attention sources.

The neural flame can serve as an object of contemplative focus embodying symbolic meaning of varying significance.

10 According to another aspects of the present invention, there is provided for the first time a method for attracting enhanced attention, the method comprising the steps of:

(a) generating a lacunar pulse train having characteristics of a pulse frequency of approximately four Hertz and a pulse-train fractal dimension of approximately one-half generated from a random walk over successive 300
15 millisecond intervals, each step being of equal magnitude and representative of a pulse train satisfying a fractal dimension equation of $\ln(\text{number of intercepts of a neuron's net input with a firing threshold})/\ln(\text{the total number of 300 ms intervals sampled})$;

20 (b) transmitting said input signal to at least one controllable light source; and

(c) pulsatingly operating said at least one controllable light source to produce a neural flame emitted from said at least one controllable light source as a result of said lacunar pulse train.

25 According to another aspect of the present invention, there is provided for the first time a method for attracting enhanced attention, the method including the steps of: (a) generating a lacunar pulse train having characteristics of a pulse frequency of approximately four Hertz and a pulse-train fractal dimension of approximately one-half; (b) transmitting the input signal to at least one controllable
30 light source; and (c) pulsatingly operating at least one controllable light source to produce a neural flame emitted from at least one controllable light source as a result of the lacunar pulse train is adapted to serve as a uniquely-identifiable signal

beacon over potentially-competing attention sources by selectively triggering human or artificial anomaly-detection filters, thereby attracting enhanced attention.

Preferably, the method further includes the step of: (d) monitoring a random-walk trace for trace-axis crossings of a firing threshold, and wherein the
5 trace-axis crossings result in activation transitions to generate pulse-activation sequences of the lacunar pulse train.

Advantageously, the method further includes the steps of: (e) filtering candidates of the pulse-activation sequences based on a zeroset dimension; and (f) filling the candidates into a buffer of selected sequences having a fractal
10 dimension of approximately one-half.

Preferably, the method further includes the steps of: (g) randomly withdrawing filtered patterns from the selected sequences in the buffer; and (h) using the filtered patterns as the input signal.

Advantageously, uniquely-identifiable signal beacon reduces distraction by
15 providing a preferential alert over the potentially-competing attention sources.

Preferably, neural flame serves as an object of contemplative focus embodying symbolic meaning of varying significance.

These and further embodiments will be apparent from the detailed description and examples that follow.

20

Brief Description of the Drawings

Embodiments of the present invention are described below, by way of example only, in which:

25 Figure 1 is a schematic view in axial cross-section of a container according to an embodiment of the present invention;

Figures 2 and 3 are schematic axial partial cross-sectional views of an embodiment of two fractal containers in the process of being coupled together;

Figures 4 and 5 are schematic axial partial perspective views of the two
30 fractal containers of Figures 2 and 3 in the process of being coupled together;

Figure 6 shows various views of another embodiment of fractal container;

Figures 7 to 9 show the coupling and uncoupling of two containers as per the embodiment of Figure 6;

Figures 10 and 11 show, respectively, the coupling together of two further embodiments of fractal container;

5 Figure 12 is a simplified high-level schematic diagram depicting a neural-flame device for attracting enhanced attention, according to embodiments of the present invention;

Figure 13 is a simplified flowchart of the major process steps for operating the neural-flame device of Figure 12, according to embodiments of the present
10 invention;

Figure 14 depicts a trace of the time evolution of input to a neuron-like thresholding unit of the neural-flame device of Figure 12, according to embodiments of the present invention; and

Figure 15 depicts a video stream for detecting fractal beacons within a generalized scene from the neural-flame device of Figure 12, according to
15 embodiments of the present invention.

Description of the Preferred Embodiments

20 a) Food Container

The description that follows and its accompanying drawings disclose in broad terms the teachings herein. Elements that are common in the art are omitted for the sake of clarity, such as but not limited to the specific materials that
25 the container may be made of, typical volumes for the container and so on. Furthermore, the drawings are not to scale.

The concept disclosed herein makes use of a fractal profile for the wall of the container, which has been found to provide a number of advantageous characteristics when applied to a container particularly for food and beverage
30 products. The skilled person will appreciate that the profile of the wall will not be of pure fractal form but will have a form dictated by practical considerations such as the minimum practical or desirable size of its fractal components.

Nevertheless, the relationship between elements of the profile is fractal in nature. In practical embodiments, the fractal container may exhibit a fractal interpretation over two or more size scales.

Referring to Figure 1, this shows in schematic form a transverse cross-sectional view of an embodiment of container 10 for use, for example, for beverages. The container has a wall 12 with an external surface 14 and an internal surface 16. The wall 12 has a substantially uniform thickness.

As with known containers, especially for food products, the wall 12 is preferably made of a food safe material or otherwise provided with a food safe inner lining. For this purpose, and as known in the art, the wall may be a single layer material or may be made as a laminate of different materials. The wall may be made of or comprise a plastics material, a metal or metal alloy or an elastomeric material. It is also envisaged that in some embodiments the wall may be made from flexible or potentially flexible food product (for example pasta, dough, licorice and so on).

The wall 12 has a fractal profile which provides a series of fractal elements 18-28 on the interior and exterior surfaces 14, 16. It is to be understood that these fractal elements 18-28 have fractal characteristics within practical considerations determined for example by the limits of the chosen manufacturing/forming process, the material chosen for wall, the thickness the wall and so on. In practice, the fractal elements 18-28 will typically reach a minimum practical dimension determined by such constraints.

The fractal elements 18-28 of the wall create, as a result of the wall 12 having a generally uniform thickness, a series of pits 40 and bulges 42 in the profile of the wall, in which a pit 40 as seen from one of the exterior or interior surfaces 12, 14 forms a corresponding bulge 42 on the other of the exterior or interior surfaces 12, 14, and vice versa. This characteristic is exhibited both on a large scale, for instance with the pits 40 and bulges 42 identified by the reference numerals in Figure 1, but also with the smaller ones of the fractal elements 18-28. The pits 40 and bulges 42 could be described as opposite images of one another on the exterior 14 and interior 16 sides of the walls 12. Repeating features (for instance pits and bulges) across a variety of scales creates the fractal form or

profile on the container surfaces. The fractal profile may extend across the entire area of the container surfaces or only over selected surfaces or surface portions. Thus, the fractal profile may in some embodiments extend over the entire container, while in other embodiments the majority of the container can be smooth
5 with only the contact areas between containers having fractal formations.

It will be appreciated that Figure 1 is an axial cross-sectional view only. The fractal elements 18-28 may in some embodiments extend in linear fashion along the length of the wall 12, but in other embodiments the elements 18-28 may be of pure fractal form of a type akin, so to speak, to cauliflower or broccoli florets,
10 so as to create an array of distinct nodules, both circumferentially and also longitudinally along the wall 12.

The container 10 may be of generally cylindrical form, such that the cross-section shown in Figure 1 extends into and/or out of the plane of the paper. In such embodiments, the container 10 will include a top and a base, typically of
15 any type known in the art.

The container 10 of this embodiment, and of the other embodiments described and contemplated herein, provides a number of practical advantages. One such advantage can be seen with reference to the embodiment shown in Figures 2 to 5.

20 Referring first to Figures 2 and 3, these are axial cross-sectional views of two containers 100, 110 similar to the view of Figure 1 but in which only a part of the circumference of the wall of each container can be seen. Each container 100, 110 has, as with the embodiment of Figure 1, a wall 12 having exterior 14 and interior 16 surfaces and fractal elements 18-28 formed in the wall and present in
25 the exterior and interior surfaces 14, 16.

The containers 100, 110 have the same shapes and fractal profiles, which are also symmetrical as will be apparent from the Figures. This correspondence in shapes enables the pits 40 and corresponding bulges 42 in the walls of the two containers 100, 110 to engage into one another so as to interlock along a portion
30 of their circumferences, as can be seen in particular in Figure 3. In this embodiment, the pits 40 and bulges 42 have the same, but opposite, shapes such that they are able to fit snugly into one another. This can be achieved, in some

embodiments, by creating two identical fractal sheets and curving them in opposite directions such that one surface of one the sheet becomes the outer surface of one container and the same surface of the other sheet becomes the inner surface of the other container.

5 Furthermore, in the embodiments of Figure 1 to 3, the pits 40 and bulges 42 have what could be described as enlarged heads with narrower neck portions, in which the fractal elements extend to a smaller width or diameter d at or close to their bases compared to a larger width or diameter D further from their bases. This characteristic of enlarged heads may be prevalent in all of the pits 40 and bulges
10 42 but in other embodiments may be exhibited in only a portion of the fractal formations in the wall 12.

As can be seen in Figure 3 in particular, the coupling of the two containers 100, 110 occurs, in this example, because the containers have a generally curving or rounded form, in which case the containers will only touch, and inter-engage, at
15 their tangents.

In other embodiments that have different general overall shapes, such as square or polygonal, the coupling of the fractal formations of two containers may occur across an entire side wall or a portion of one or more of the side walls of the containers.

20 When used for packaging, this characteristic enables multiple containers to be coupled together without the need for any other tie mechanism of the types commonly used in the art. In other words, two or more containers 100, 110 may be joined together solely by inter-engagement of some of the fractal formations of the container walls 12. The containers need not have tessellating shapes, as it is
25 only necessary for one or more of the fractal formations of each of the containers to inter-engage in order to achieve coupling.

Figures 4 and 5 show a view of another embodiment similar to that of Figures 2 and 3, in which the fractal formations of the containers 100, 110 extend generally linearly for at least a short distance longitudinally, in other words in two-
30 dimensional manner rather than in a three-dimensional manner as a floret would. In this embodiment, the same fractal elements of the containers 100, 110 shown in Figures 4 and 5 will inter-engage longitudinally along their length, and if they

extend along the entire length of the containers they will then inter-engage equally along the length of the containers. In the case of three-dimensional fractal elements, of what could be described as floret form, inter-engagement of two or more containers along a tangent thereof will involve the coupling of multiple fractal
5 formations along the lengths of the containers.

The containers can be uncoupled by squeezing the containers 100, 110, for example from either side of the coupling zone, to cause the engaged pits 40 and bulges 42 to deform and open out. A user can in this manner separate the containers 100, 110 with relative ease.

10 Referring now to Figure 6, this shows another embodiment of fractal container 200 having a fractal form similar to that of the embodiments of Figures 1 to 5. In this embodiment, the fractal formations extend in linear manner along the length of the container 200, as can be seen in particular in the perspective view of Figure 6. The container 200 can have any of the characteristics described
15 elsewhere herein.

With reference to Figure 7, in this embodiment the pits 240 and bulges 242 are not the same shape or size to fit one within the other precisely, as is the case with the embodiments shown in Figures 2 to 5. Nevertheless, the pits 240 and bulges 242 are still able to engage partially, as will be apparent in the Figure. The
20 two containers can be tied to one another by adhesive posited into the interstice or pocket 244 between the partially engaged pits 240 and bulges 242. More than two containers may be coupled together in this manner, in a fully or partially tessellating manner depending upon the shapes of the containers.

The containers 200 can be separated from one another by applying
25 pressure to one or both of the containers, as shown in Figure 8. In the example shown in this Figure, the pressure may be applied diametrically opposite the adhesive coupling 244, as per the arrow in the Figure. This pressure will cause deformation of the walls 12 of the containers and, as a consequence, apply shear stress (and typically also compressive and tensile forces) to the adhesive in the
30 pocket 244, which will break or loosen. It will be appreciated that the containers could be squeezed from other directions and achieve the same result.

Once the adhesive coupling has been released, the containers 200 can be separate from one another as shown in Figure 9.

Referring now to Figure 10, this shows in schematic form partial wall profiles of two fractal containers 300, 300' according to another embodiment of the present invention. In this embodiment, the wall has what could be described as a fractal random walk profile, with zig-zag wall elements of different lengths l_1 - l_n .

The two container profiles 300, 300' preferably have substantially identical reversed or replicated profiles in at least a part of their extent, such that they can couple together in a precise nesting arrangement, as shown in Figure 10B. The two fractal elements 300, 300' can thus be coupled together, typically by a combination of mechanical inter-engagement and friction. The skilled person will appreciate that in this embodiment, as with the following embodiment shown in Figure 11, the profile does not include any fractal elements having bulges or pits with enlarged heads, as occurs with the embodiments of Figures 1 to 9, although it is not excluded that in some embodiments they may have such characteristics.

Figure 11 shows another example, in which the profiles of the two containers 400, 400' only partially nest one into the other. It will be appreciated that the degree of coupling of the containers together can be altered by adjusting the fractal profiles of the two inter-engaging surfaces to one another.

In the preferred embodiments, the lengths l_1 - l_n of the zig-zag wall elements are advantageously determined as statistical fractals whose dimensions may be tuned via random walk parameters to optimize the interlocking of two or more fractal containers. Bonding between containers can be relatively strong with an increased number and size of capture points and weaker with fewer capture points.

In the embodiments of Figures 10 and 11, inter-engagement can be provided by the profiles themselves and optionally, as per the above described embodiments, assisted by the use of adhesive between adjacent containers.

The forms of container disclosed herein provide a number of other advantages in addition to an increased ability to couple multiple containers together.

First, the fractal nature of the outer surface of the container provides a better grip of the container compared to a container having a smooth outer surface. This can be advantageous particularly with larger or heavier containers, in respect of which a good grip can be obtained with less holding pressure on the
5 container wall.

Moreover, the corresponding convex and concave fractal elements provide for increased surface area of both the interior and exterior surfaces of the container relative to a volume of the chamber. This can be useful in increasing the heat transfer characteristics of the container, for instance to cool or heat its
10 contents.

The skilled person will appreciate that the teachings herein can provide other advantages and characteristics not exhibited in containers known in the art.

b) Devices and Methods for Attracting Enhanced Attention.

15 The present invention relates to devices and methods for attracting enhanced attention. The principles and operation for providing such devices and methods, according to aspects of the present invention, may be better understood with reference to the accompanying description and the drawings.

20 Referring to the drawings, Figure 12 is a simplified high-level schematic diagram depicting a neural-flame device for attracting enhanced attention, according to embodiments of the present invention. A neural-flame device **2** includes a support **4** serving as a beacon or an imitation candle, which may be configured to accommodate the needs of the application (regarding physical
25 dimensions) such as an emergency alert or as an object of contemplative focus embodying varying significance.

Neural-flame device **2** has a controllable light source **6** (e.g., an LED component) with an optional translucent cover **8**, which can be shaped like a neuron's cell body or soma. Controllable light source **6** can incorporate any type of
30 light-emitting device. Neural-flame device **2** includes a base **10** housing an optional digital-to-analog (D/A) converter (D/A module **12**) and an input connector **14** for supplying a digital input signal for driving controllable light source **6** with the

required voltage sequence at a frequency corresponding to approximately 4 Hz and a fractal dimension near $\frac{1}{2}$. It is noted that D/A module **12** can be implemented as hardware, software, and/or firmware as an integral component of a dedicated processor for neural-flame device **2**.

5 Figure 13 is a simplified flowchart of the major process steps for operating the neural-flame device of Figure 12, according to embodiments of the present invention. The process starts with the system generating pulse trains having a frequency of approximately 4 Hz and a fractal dimension of near $\frac{1}{2}$ (Step **20**). A system buffer is then filled with these special lacunar pulse trains (Step **22**). These
10 pulse trains are then sequentially withdrawn from the buffer, and then transmitted to controllable light source **6** via input connector **14** (Step **24**).

Optionally, pulse trains may be randomly removed from the buffer prior to transmitting the signal to controllable light source **6** (Step **26**). Such aspects are elaborated on in greater detail with regard to Figure 14.

15 Figure 14 depicts a trace of the time evolution of input to a neuron-like thresholding unit of the neural-flame device of Figure 12, according to embodiments of the present invention. The trace represents the output of a random-walk algorithm carried out on a computer or processor that is in turn applied to a neuron-like thresholding unit resulting in a series of activation
20 transitions as the trace crosses (i.e., intersects) the "neuron's" firing threshold. The arrival patterns of these activation transitions are then filtered by an algorithm that calculates fractal dimension (i.e., zero-set dimension of the trace), and fills a buffer with those transition patterns having an approximate fractal dimension of $\frac{1}{2}$. These filtered patterns are then withdrawn from the buffer, and transmitted to drive the
25 controllable light source.

The algorithm may be generated in an onboard processor and power supply all within base **10** of neural-flame device **2**. It is noted that not only do such pulse patterns represent the desired 4 Hz, fractal dimension $\frac{1}{2}$ pulse trains, but they largely differ from one another, thus preventing any anomaly detection filter,
30 biological or not, from adapting to repeating activation streams.

The neuron-activation stream is generated by inputting a form of random walk of equal-sized steps to the neuron, with each such step being a notional 'coin

flip' to determine whether the step is positive or negative in sign. As the random input crosses the neuron's firing threshold (as depicted in Figure 14), a pulse is triggered by the algorithm, the source of analog input to drive controllable light source **6** of neural-flame device **2**.

5 Returning to optional Step **26** of Figure 13, the resulting stream of the lacunar pulse train can be used as a set of candidate activation sequences that are then randomly withdrawn from the buffer, and transmitted to drive controllable light source **6**.

 The random walk may be started repeatedly from zero in a series of trials, calculating fractal dimension for each, and then accumulating a library (i.e., a
10 buffer) of just those short pulse sequences having the required fractal dimension near $\frac{1}{2}$. Step **26** may be accomplished in nanoseconds, and the sequences computationally slowed to near 300-ms timescales prior to being transmitted to controllable light source **6**.

15 Other techniques may be employed as well to mitigate such effects, as known in the art. However, randomly withdrawing short pulse trains from the buffer has an advantage in that it adds another layer of randomness to the pulse train, allowing it to stand out when viewed through an anomaly detector, either in the brain or an artificial neural network-based novelty filter. With small pulse-train
20 libraries, there is a chance of repetition as the short pulse trains are appended to each other, making it easier for the anomaly filter to adapt to them.

 Such a "baseline reset" has been described (Thaler 2014). The fractal signature of the random walk is determined largely by its step size. In the case of the neural flame, the random walk is tuned to provide a trace (i.e., a wiggly line)
25 that has a fractal dimension of 1.5. Sampling the crossings (i.e., intersections) of that trace with a baseline that is purposely introduced mid-channel yields a zeroset dimension of one less than that of the trace's fractal dimension, namely 0.5.

 It is noted that the rigorous fractal dimension calculation (i.e., Mandelbrot Measures) is immune to the regions in which the trace departs from the baseline.
30 Without directly viewing the trace, the zeroset dimension may be verified by waiting until the trace resumes its baseline crossings again, and then calculating how these intersections scale with time.

In Thaler 2014, the reset involves seeking the nearest memory to the network's current output pattern and using that as a new reference to measure how far that vector has walked. The equivalent of a single neuron's activation crisscrossing a baseline, the output pattern oscillates through a point in a
5 multidimensional space.

Figure 15 depicts a video stream for detecting fractal beacons within a generalized scene from the neural-flame device of Figure 12, according to embodiments of the present invention. Using a machine vision system, the video stream is propagated through an adaptive auto-associative neural net used as an
10 anomaly filter. With periodic, random, and fractally-tuned beacons (as depicted in (a) "raw scene" of Figure 15), the anomaly filter (as in (b) of Figure 15) can block out the anomalies representing the periodic source (as in (c) of Figure 15). Subsequent algorithmic steps (as in (d) of Figure 15) calculate the fractal dimension of each anomaly's activation stream, enabling separation of any
15 random source from that having a tuned fractal dimension (as in (e) of Figure 15). Thus, the use of fractal dimension at frequencies close to the clock cycle of the human brain, around 250-300 milliseconds, serves to enhance attention over other potentially-competing attention sources by selectively triggering the physiological anomaly-detection filtering of the brain.

20 To generate pulse trains to drive neural-flame device **2**, input to a computational neuron takes the form of a random walk over successive 300-millisecond intervals, each step being of equal magnitude (Figure 14). The aggregate intersections with the time axis represent the zeroset, with each of these points ultimately representing a pulse within the sequence driving neural-
25 flame device **2**.

As these candidate pulse trains are generated, they are assessed for their zeroset (or fractal) dimension, D_0 , which is approximated as: $D_0 = \ln(N_0)/\ln(N)$, wherein N is the total number of 300 millisecond intervals sampled, and N_0 is the total number of intercepts of the neuron's net input with the firing threshold. As any
30 new firing pattern is assessed with a fractal dimension near $\frac{1}{2}$, the pattern is stored within a memory buffer or array. Subsequently, such pulse trains are

randomly accessed and transmitted to D/A module **12** where they are converted to analog voltages to drive the neural flames of controllable light source **6**.

Alternatively, use of a storage buffer may be sidestepped by using an optimization algorithm that varies the step size of input variations to the neuron
5 until the average fractal dimension of the pulse trains evaluate to the desired fractal dimension.

For use as a signal beacon, humans may search with or without the aid of a camera and machine-vision system. In the latter case, the camera's video stream may be viewed through an anomaly detector, the preferred embodiment being an
10 adaptive auto-associative net that calculates the difference vector between the filter's input and output patterns, $\Delta \mathbf{P} = \mathbf{P}_{in} - \mathbf{P}_{out}$, thus producing a map of anomalies within the camera's field of view. Subsequent filters then calculate the fractal dimension of anomalies appearing in this filtered view. Using such a methodology, not only can fractal dimension $\frac{1}{2}$ sources be identified, but a range
15 of prespecified fractal dimensions in the range (0, 1), opening a whole new approach to secure signaling and communication.

Furthermore, aspects of the present invention provide an object of contemplative focus embodying symbolic meaning of varying significance (e.g., philosophical/religious) due to the fact that the unique fractal rhythms used are
20 those thought to: (1) be exploited by the brain to detect idea formation, and (2) have grandiose meaning as the temporal signature of creative cognition, whether in extraterrestrial intelligence or cosmic consciousness.

While the present invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications,
25 equivalent structural elements, combinations, sub-combinations, and other applications of the present invention may be made.

The disclosures in European patent application numbers EP18275163.6 and EP18275174.3, from which this application claims priority, and in the abstract accompanying this application are incorporated in their entirety by reference.

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