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RELATION OF SPATIAL GRASP PARADIGM TO PHILOSOPHICAL AND PSYCHOLOGICAL CONCEPTS

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Анотація. *Стаття наслідує практичні роботи, присвячені створенню у Києві (Україна) перших загальноміських комп'ютерних мереж, які об'єднували різні інститути Національної академії наук та інші організації з кінця шістдесятих років задовго до появи Інтернету. В результаті цих робіт постала нова концепція управління і методологія та технологія розподіленого управління, спочатку відома як WAVE, яка й надалі розвивалася і використовувалася в різних країнах світу в таких сферах, як мережеве управління, промисловість, соціальні системи, колективна робототехніка, військове командування та управління, антикризисне управління, національна та міжнародна безпека, оборона, розподілене моделювання, космічні системи тощо. У статті аналізується відношення розробленої Моделі просторового захоплення, результуючої Мови просторового захоплення (МПЗ) і Технології просторового захоплення (ТПЗ) до деяких психологічних і філософських понять вищого рівня. Робота представляє основи МПЗ і ТПЗ, а також деталі їх реалізації, обговорює можливий зв'язок цих понять із деякими законами теорії гештальта, такими як закон близькості, закон «хорошого» гештальта і закон фігури та фону. На прикладі динамічного рою переслідуваних одиниць стаття також показує, як за допомогою ТПЗ сформувати свого роду розподілену і глобальну обізнаність, що може забезпечити посилені оперативні можливості рою і практично використовуватися для організації колективної поведінки багатьох роботизованих блоків, які досліджують невідомі середовища з жорсткими умовами. У статті згадується, як ТПЗ може бути пов'язаною з такими вищими ментальними поняттями, як сприйняття, свідомість і навіть душа. Також вона демонструє зв'язок концепції ПЗ і її реалізації з теорією патернів, при цьому патерн розглядається як фундаментальна та універсальна концепція в багатьох сферах людської діяльності, яка фактично протиставляється термінам логіки.*

Ключові слова: *парадигма просторового захоплення, мережева реалізація, закони теорії гештальта, глобальна обізнаність, свідомість, душа, колективна поведінка, патерни, теорія патернів.*

Abstract. *The paper follows practical works on the creation of the first citywide computer networks in Kyiv (Ukraine) which have been integrating different institutes of the National Academy of Sciences and other organizations from the end of the sixties, well before the internet. These works resulted in a new management concept and distributed control methodology and technology, originally called WAVE, which were further developed and demonstrated in different countries in the areas like network management, industry, social systems, collective robotics, military command and control, crisis management, national and international security, defense, distributed simulation, space-based systems, and many others. The current paper analyses the relation of the developed Spatial Grasp Model, resultant Spatial Grasp Language (SGL), and Spatial Grasp Technology (SGT) to some higher-level psychological and philosophical concepts. By providing the basics of SGL and SGT and details of their implementation, it discusses the possible relation of these concepts to some gestalt theory laws like the Law of Proximity, Law of Good Gestalt, and Law of Figure and Ground. The paper also shows how to organize a sort of distributed and global awareness under SGT on an example of a dynamic swarm of chasing units, which can provide the increased operational capability of the swarm and be practically used for the organization of collective behaviour of multiple robot units exploring unknown and harsh environments. The paper mentions how SGT may relate to higher mental concepts like perception, consciousness, and even soul. It also shows relations of SG concept and its implementation to the pattern theory, with pattern considered as a fundamental and universal concept in many areas of human activity, which actually stands in opposition to the terms of logic.*

Keywords: *Spatial Grasp paradigm, networked implementation, gestalt theory laws, global awareness, consciousness, soul, collective behaviour, patterns, pattern theory.*

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1. Introduction

This paper follows practical works on the creation of citywide computer networks in Kyiv, Ukraine, from the end of the sixties, which have been integrating different institutes of the National Academy of Sciences and other organizations, with the active participation of the current author [1–4]. By spreading a fully interpreted scenario code in a wave-like mode between different computers we were able to solve complex analytic-numerical problems on heterogeneous computer networks that were difficult to organize on individual computers. These works resulted in a new management concept and distributed control methodology and technology which were further developed in different countries (including Ukraine, former Czechoslovakia, Germany, the UK, the US, Canada, and Japan). The applications included such areas as intelligent network management, industry, social systems, collective robotics, military command and control, crisis management, national and international security, defense, distributed simulation, physical-virtual symbiosis, space-based systems, and even biology, psychology, and art. These works resulted in many international publications which include European patent [5] and Wiley, Springer, Emerald, and Taylor & Francis books [6–13], with the latest papers by [14–16]. The developed concept was demonstrated at the universities of Braunschweig and Karlsruhe in Germany, Oxford and Surrey in the UK, British Columbia in Canada, Oita and Aizu in Japan, and California at Irvine in the US. A number of successful implementations of this approach had been made in such programming languages as Analytic, Fortran, Lisp, and C.

The aim of the paper is to investigate and show how the developed Spatial Grasp paradigm may relate to some higher-level psychological, philosophical, and mental concepts, which may considerably increase integrity, intelligence, and practical capabilities of large distributed systems of both terrestrial and celestial nature.

The work is organized as follows. Section 2 describes the main features of the Spatial Grasp Model and its basic Spatial Grasp Language, including their implementation and existing application areas. Section 3 discusses the possible relation of SGL to gestalt theory laws, showing how to organize gestalt-based distributed vision under SGT using the Law of Proximity, by starting the space observing from any single point or many points in parallel. It also discusses the relation of the found results to the Law of Good Gestalt, by evaluating the compactness of the obtained images in a group as their gestalt quality. The Section also shows how to simulate the gestalt's Figure/Ground Expression in SGL by finding a spatial figure surrounded only by spatial ground, and no other images, also finding and collecting all figure's border addresses. Section 4 shows how to organize a sort of distributed and global awareness under SGT on the example of a dynamic swarm of chasing units. This includes such examples as elementary swarming with only local awareness, deeply embedded into the swarm the overall awareness, superior and migrating global awareness, as well the outside activated eternal global awareness. Section 5 shows how SGT may relate to much higher mental and philosophical concepts like perception, consciousness, and even soul. Section 6 links the ongoing research on SG paradigm to the notion of pattern, which is generally considered one of the most fundamental and universal concepts in many areas of human activity, ranging from mathematics, construction, and technologies to human behavior. Section 7 concludes the paper.

2. Holistic Spatial Grasp Model and Technology

The distributed management control model and technology main ideas are briefed, with many other details easily found in [5–16].

2.1. Spatial Grasp Technology basics

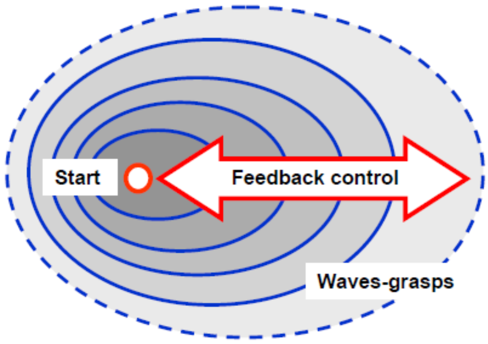


Figure 1 – The main idea of Spatial Grasp Model

Within Spatial Grasp Technology (SGT), a high-level scenario for any task to be performed in a distributed world is represented as an active self-evolving pattern rather than a traditional program, sequential or parallel. This pattern, written in a high-level Spatial Grasp Language (SGL) and expressing the top semantics of the problem to be solved, can start from any point of the world. Then it spatially propagates, replicates, modifies, covers, and matches the distributed world in a parallel wave-like mode, while echoing the reached control states and data found or obtained for making decisions at higher levels and further space navigation, as symbolically shown in Fig. 1.

2.2. The worlds SGT operates with

SGT allows direct operation with different world representations: Physical World (PW), considered as continuous and infinite, where each point can be identified and accessed by physical coordinates; Virtual World (VW) which is discrete and consists of nodes and semantic links between them; and Executive world (EW) consisting of active “doers” with communication possibilities between them. Different kinds of combinations of these worlds can also be possible within the same formalism. More details on SGT worlds can be found in [8–16].

2.3. Spatial Grasp Language syntax

SGL top-level syntax is shown in Fig. 2.

grasp	→	*constant* | *variable* | *rule* [({ ***grasp***,})]
constant	→	*information* | *matter* | *custom* | *special* | ***grasp***
variable	→	*global* | *heritable* | *frontal* | *nodal* | *environmental*
rule	→	*type* | *usage* | *movement* | *creation* | *echoing* | *verification* | *assignment* | *advancement* | *branching* | *transference* | *exchange* | *timing* | *qualifying* | ***grasp***

Figure 2 – Basic recursive structure of Spatial Grasp Language

An SGL scenario, or *grasp*, applied in some point of the distributed space, can just be a *constant* directly providing the result to be associated with this point. It can be a *variable* whose content, assigned to it previously when staying in this or (remotely) in another space point, provides the result in the application point. It can also be a *rule* (expressing certain action, control, description, or context) optionally accompanied with operands and embraced in parentheses. These operands can be of any nature and complexity and defined recursively as grasp too. The full description of the latest SGL versions can be found in [8–13].

2.4. SGL rules

Rules, starting in some world points, can organize navigation of the world sequentially, in parallel, or in any combinations thereof. They can result in staying in the same application point or can cause movement to other world points with the obtained results to be left there, as in the final points of the rule. Such results can also be collected, processed, and returned to the starting point of the rule. The final world points reached after the rule invocation can themselves become starting ones for other rules. More details on SGL rules are in [8–16].

2.5. SGL variables

SGL variables include *Global variables* (the most expensive and rarely used ones) which can serve any SGL scenarios and be shared by them, also by their different branches; *Heritable variables* appearing within a scenario step and serving all subsequent, descendent steps; *Frontal variables* serving and accompanying the scenario evolution, being transferred between subsequent steps; *Environmental variables* allowing us to access, analyze, and possibly change different features of physical, virtual and executive worlds during their navigation; and finally, *Nodal variables* as a property of the world positions reached by scenarios and shared with other scenarios in the same positions.

2.6. Elementary SGL programming examples

`add(7,8)` – finds the sum of two.

`add(7,8)` – finds the sum of two values when staying in some world point and leaves the result there.

`assign(Result, add(7,8))` – the sum of two values found is assigned to a variable result which will stay at the same point.

`move(x_y)` – makes a physical move from the current world point to another physical point with the given coordinates. The resultant control will be associated with the reached position.

`advance(move(x1_y1), move(x2_y2))` – from the current world point provides a physical move by the coordinates `x1_y1`, and then from the reached destination provides another move by `x2_y2` coordinates. Using traditional semicolon as a separator of the operations following each other instead of rule `advance` can be allowed too, like `move(x1_y1); move(x2_y2)`. The resultant control will be associated with the position reached after the second move.

`branch(move(x2_y7), move(x4_y9))` – physical movement from the current location independently, possibly in parallel, to new locations `x2_y7` and `x4_y9`, with the resultant control staying simultaneously in the reached locations. Other representations of this example may be as follows:

`parallel(move(x2_y7), move(x4_y9))` or

`move(x2_y7), move(x4_y9)` or

`move(x2_y7, x4_y9)`

`create(John)` – creates isolated virtual node John, with the control staying in this node.

`hop(John); create(+father, Peter)` – extends the existing single node of the virtual network with a new node and relation to it, where John will be treated as a father of Peter. The resultant control will be in the new node Peter.

`move(x_y); repeat(shift(dx_dy); TEMPERATURE > 0)` – starting from the world point with the proper coordinates, organizes repetitive movement in the chosen direction unless the temperature in the reached physical locations remains above zero. The resultant control will be in the final reached position.

`output(move(x_y); repeat(shift(dx_dy); TEMPERATURE > 0); WHERE)` – extends the previous example with printing the coordinates (using environmental variable `WHERE` for lifting them) of the latest positively reached node in physical space, whatever remote it might be, by issuing this result in the position from which this scenario was launched, with the final control remaining in it as well.
`if(hop(Peter), create(Lilia, Olga, Ann))` – in case of the existence of the virtual node Peter, three new isolated virtual nodes with proper names will be created. The resultant control will stay in parallel in the three created nodes.
`hop(Nick);output(if((hop(Fighter); fire(x_y)), 'success', 'failure'))` – ordering soldier `Nick` to use robot `Fighter` to fire by coordinates `x_y` with the confirmation of success or failure of this operation to be received by Nick. The resultant control will be in Nick.
`output(if((hop(Nick); hop(Fighter); fire(x, y)), 'success', 'failure'))` – is similar to the previous one but the confirmation of the success or failure to be directly received by the person or institution that made this order.

2.7. SGL spatial interpretation

An SGL interpreter consists of a number of specialized functional processors working with specific data structures, as in Fig. 3 (with processors shown as rectangles, and data structures as ovals). These include Communication Processor (CP), Control Processor (CoP), Navigation Processor (NP), Parser (P), different Operation Processors (OP), and a special World Access Unit (WU). The main data structures comprise Grasps Queue (GQ), Suspended Grasps (SG), Track Forest (TF), Activated Rules (AR), Knowledge Network (KN), Grasps Identities (GI), Global Variables (GV), Heritable Variables (HV), Fontal Variables (FV), Nodal Variables (NV), Environmental Variables (EV), Incoming Queue (IQ), and Outgoing Queue (OQ). Each interpreter can support and process multiple SGL scenario codes which happen to be its responsibility at different moments of time (using CoP, NP, P, OP, WU, GQ, SG, TF, AR, KN, GI, GV, HV, FV, NV, EV, IQ, OQ) and also exchange scenario code and data with other SGL interpreters (using CP, CoP, NP, WU, TF, KN, HV, FV, EV, IQ, OQ). More details on the organization of the SGL interpreter can be found in [8–18].

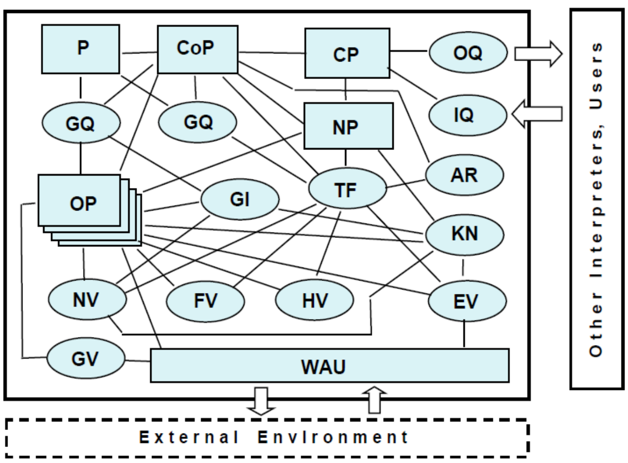


Figure 3 – The main components of SGL interpreter and their interactions

Communicating interpreters of SGL can be in an arbitrary number of copies, up to millions and billions, which can be effectively integrated with any existing systems and communications, and their dynamic networks can represent powerful spatial engines capable of solving any

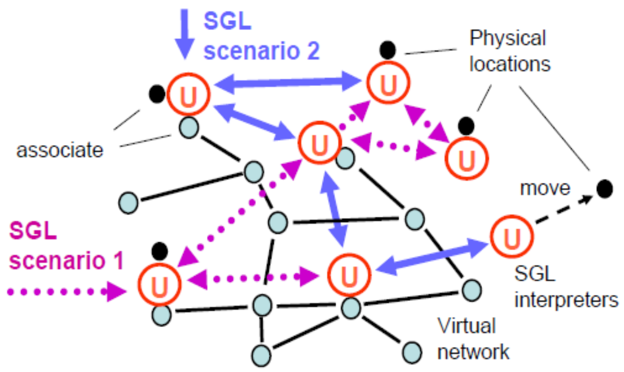


Figure 4 – SGL distributed interpretation in physical and virtual environments

problems in terrestrial and celestial environments. Such collective engines can simultaneously execute different cooperative or competitive scenarios without any central resources or control. Hardware or software SGL interpreters, shown in Fig. 4 as universal computational, control and management units U, may be stationary or mobile. They can be dynamically installed, and if needed created, in proper physical or virtual world points on the request of self-evolving SGL scenarios.

3. Gestalt-based distributed vision under SGT

3.1. Gestalt Laws

The Section is connected with Gestalt psychology and theory [17–26] emphasizing the unique capability of the human mind to directly grasp complex images as a whole while interpreting parts in the context of this whole, rather than vice versa. Using SGT, it is possible to extrapolate these features to seeing and understanding structures and situations distributed throughout large spaces and do this remotely and in parallel. There are known the following gestalt laws: Law of Proximity, Law of Similarity, Law of Continuity, Law of Closure, Law of Common Fate, Law of Symmetry, Law of Figure and Ground, Law of Past Experience, Law of Good Gestalt, Uniform Connectedness (Law of Unity). The Section demonstrates in SGL only laws of proximity, good gestalt, and figure/ground controversy, while simulation of other laws in SGL can be found in [9].

3.2. Expressing the Law of Proximity

The Law of Proximity states that when individuals perceive an assortment of objects, they often first perceive objects that are close to each other as forming a group (as in Fig. 5). According to the Law of Proximity, things that are near each other seem to be grouped.

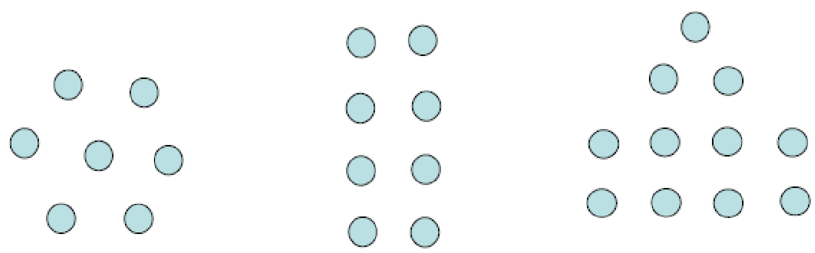


Figure 5 – Examples of proximity

Let us consider how to practically express this law in SGL with the focus on finding groups of objects close to each other like those in Fig. 5. Initially, we will start with a limited number of randomly chosen objects, in hope that each may relate to a separate group, and then with all objects in parallel, using a Depth distance between objects allowing them to belong to the same group.

Starting from randomly chosen starting objects (each is supposed to be in a different group)

Starting from each chosen object, in a spanning tree mode (with the blocking cycling), the following scenario covers all objects having distances between them not exceeding the given Depth threshold. It then returns all addresses of the reached nodes and collects them in the variable Group at the starting node, the content of which is printed in the starting node too.

```
frontal(Depth) = threshold; nodal(Start = 3, Group);
hop_objects(random, Start);
Group = repeat(done(ADDERSS), hop_first(Depth));
output(Group))
```

The resultant groups are depicted in Fig. 6 (the starting nodes-objects are colored in red).

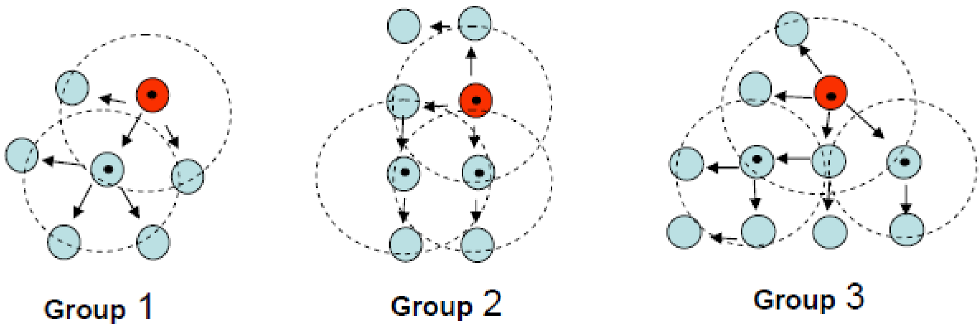


Figure 6 – The discovered groups of objects

Starting from any number or all objects (some may be in the same group)

When starting to create a group from more than one point belonging to the same group, we may get duplicate group answers from the previous scenario. The following scenario variant may start from any number of visible objects in parallel, including all of them, and in the result, each group will be presented only once. If simultaneous spanning tree coverage started from different nodes of the same group takes place, only a single spanning tree will be finally allowed to proceed. It will be from the node having the highest value defined by its X-Y address, with the immediate abortion of other trees, and the final group result will be issued in this strongest node.

```
frontal(Depth) = threshold; nodal(Group);
hop_objects(all); IDENTITY = ADDRESS;
contain(
  Group = repeat(done(ADDRESS), hop_first(Depth);
                 if(ADDRESS < IDENTITY, abort));
  output(Group))
```

3.3. Relation to the Law of Good Gestalt

The Law of Good Gestalt explains that elements of objects tend to be perceptually grouped if they form a pattern that is regular, simple, and orderly. This law implies that when individuals perceive the world, they eliminate complexity and unfamiliarity so can observe a reality in its most simplistic form [25]. We will use the simplest possible mechanism to assess the gestalt quality of the groups obtained above just in the result of the division of the group’s occupied square to the number of objects in it, as follows, see Fig. 7.

```
frontal(Depth) = threshold;
nodal(Group, MinX, MinY, MaxX, MaxY);
hop_objects(all); IDENTITY = ADDRESS;
contain(
```

```
Group = repeat(done(ADDRESS), hop_first(Depth);
               if(ADDRESS < IDENTITY, abort));
(MinX, MinY, MaxX, MaxY) = analyse(Group);
Quality = (MaxX – MinX)*(MaxY – MinY)/count(Group);
output(Quality))
```

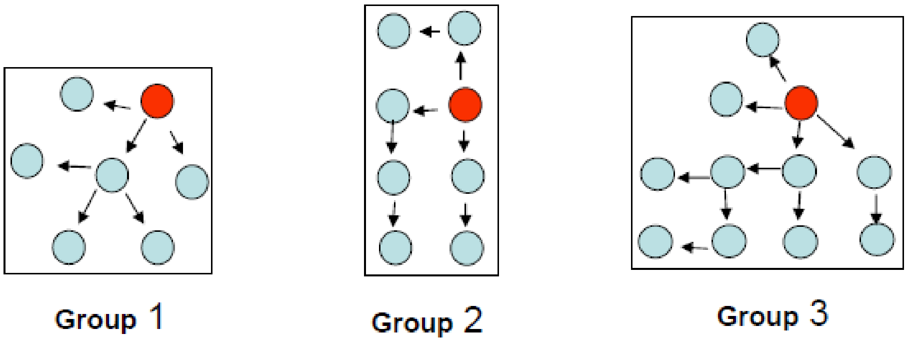


Figure 7 – Assessing the good gestalt quality of groups

The quality results will be the following: 276 for Group 1, 185 for Group 2, and 254 for Group 3. This finds Group 2 as the most compact, regular, and orderly.

3.4. Figure/Ground Expression

The Figure/Ground concept refers to the relationship between positive elements and negative space. The idea is that the eye will separate whole figures from their background in order to understand what's being seen. It is one of the first things people will do when looking at any composition. [26]. Perception of figures and grounds can change to the opposite, as in Fig. 8.

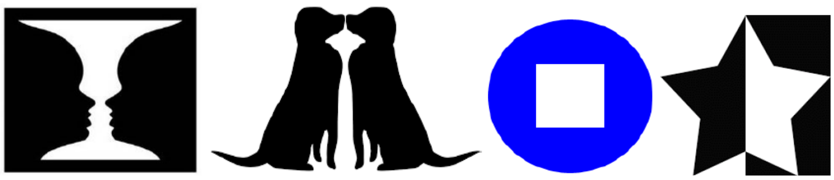


Figure 8 – Examples of figure-ground perception

A practical example chosen for the figure-ground analysis

The picture to be analyzed in SGL is shown in Fig. 9 where the figure is expected to be white and the ground space – grey. The object to be identified as a figure should only have borders with the ground, with any other combinations rejected. The scenario presented below starts at some arbitrarily chosen white locations hopefully belonging to the figures and then covers the remaining white spaces in a parallel wave-like mode (implemented by self-growing spanning trees). If this coverage reaches all points painted only in white or grey (being stopped upon reaching the grey ones), it indicates clear objects (like the one started from point 2 in Fig. 9). It will be immediately rejected by reaching any other colors (like from point 1). The following solution options can be available.

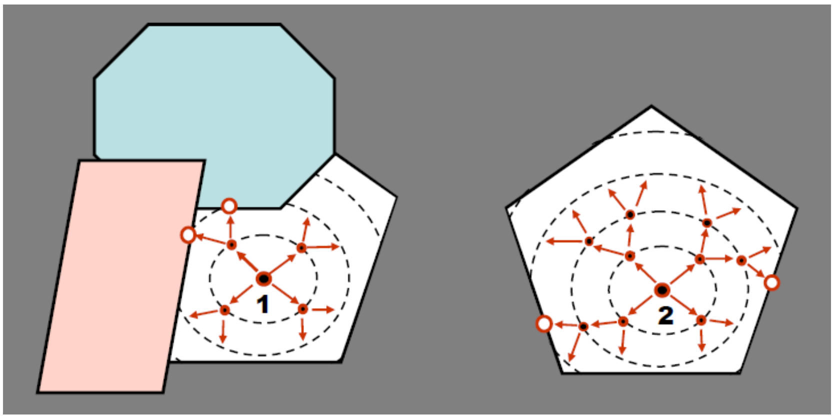


Figure 9 – An example of resolving the figure-ground controversy

Confirming that we correctly pointed at the figure

The scenario will output addresses of all starting points that belong to the identified figures.

```
nodal(P1 = address1, P2 = address2, Next);
frontal(Extent = ..., Start);
move(P1, P2); CONTENT == white; Start = WHERE;
if(
  repeat(Next = produce(Start, WHERE, Extent);
         move_all(Next);
         if(CONTENT == grey, stop);
         if(CONTENT != white, abort)),
  output(ADDRERS, “ points at Figure”)
```

The output of all figure's border addresses

The following scenario will output addresses of all reached border points of all identified figures.

```
nodal(P1 = address1, P2 = address2, Next, Border);
frontal(Extent = ..., Start);
move(P1, P2); CONTENT == white; Start = WHERE;
Border =
  repeat(Next = produce(Start, WHERE, Extent);
         move_all(Next);
         if(CONTENT == grey, stop(WHERE));
         if(CONTENT != white, abort));
output(“Figure: ”, Border)
```

4. Simulating distributed and global awareness under SGT

This section first provides a simple example of expressing in SGL a swarm of "chasers" which are constantly moving, discovering, and eliminating the distributed targets seen. Then it supplies the swarm of chasers with a sort of global awareness and even consciousness [27–43] over the whole operational area, which allows individual chasers and the swarm as a whole to improve performance. This global awareness may be deeply and naturally embedded into the communicating chasers as part of their regular functionality. It can also be organized as an additional superior level which may constantly migrate over and oversee the swarm body and the surrounding area, or even function as outside supervision regularly activated from other systems.

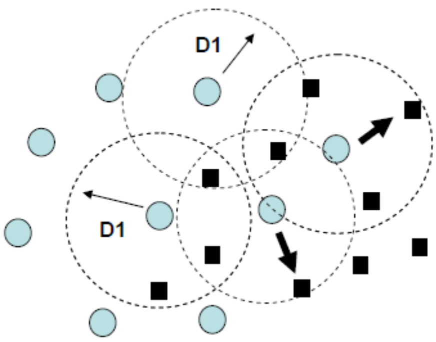


Figure 10 – A swarm of chasers discovering and fighting distributed targets

Elementary swarming

Here we will consider the situation where the operational swarm consists of chaser units named C1 to Cm, which can see (up to threshold distance D1), identify, move, and destroy reachable targets (which can move too), as in Fig. 10. In case there are no currently seen targets, each chaser may just wait for them or make a sort of random movement within the expected operational area unless some targets become visible.

```
hop_nodes(C1, C2, …. Cm);
nodal(D1 = distance, Targets);
repeat(
  Targets = search(D1); select_move_destroy(Targets);
  sleep(delay))
```

Swarms with deeply embedded overall awareness

In the previous scenario, the chasers operated in a fully distributed way, making individual local decisions to wait, move further, and attack seen targets. By enriching the swarm with a sort of global awareness over the operational area, we may essentially improve its performance locally and as a whole. We show here how this global awareness quality may be naturally embedded into the communicating chasers, where targets seen by individual chasers are regularly exchanged with their neighbors, enriching their awareness, and these neighbors exchange with their neighbors too, and so on. This makes all swarm members gradually become aware of all targets in the region, despite not all of them being visible individually, and always organize their movement in the proper direction (say, where most targets reside), see also Fig. 11.

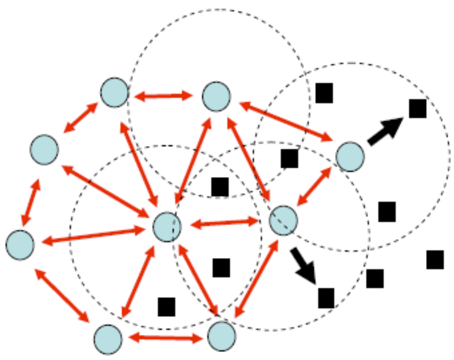


Figure 11 – Supplying the swarm with deeply embedded global awareness

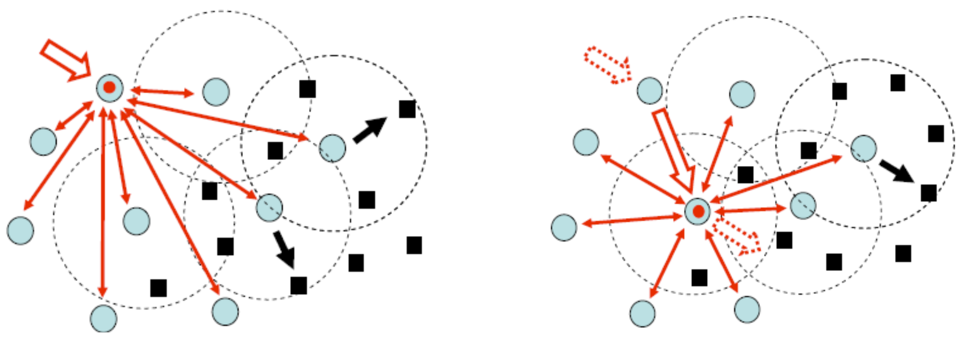
```
hop_nodes(C1, C2, …. Cm);
nodal(D1 = distance;, Targets); frontal(Exchange);
repeat(
  extend(Targets) = search(D1);
  select_move_destroy_remove(Targets);
  stay(Exchange = Targets; hop(neighbors);
       merge(Tagets, Exchange));
  sleep(delay))
```

Problem: destroyed targets should not be accounted visible anymore.

Swarms with superior migrating global awareness and consciousness

We may modify and extend the previous SGL swarm scenario by adding a higher-level awareness operating autonomously and independently over the basic swarm organization, see Fig. 12*a*. We can also organize the focus of such superior consciousness as constantly migrating between the chasers, as in Fig. 12*b*. It is supposed that this superior awareness-consciousness initially applied in any swam node, is capable to contact directly all swarm nodes in parallel and collect all they see, and then directly distribute to all nodes this global vision. In case of problems with direct communication between any nodes, this access from a node to all other nodes can be easily carried out by using a dynamic spanning tree covering the whole swarm. This will work by available communications only between neighboring nodes when the swarm covers a large area or operates in complex geographical or weather conditions.

```
nodal(D1 = distance, Targets); frontal(Global);
parallel(
 (hop_nodes(all);
  repeat(
    extend(Targets) = search(D1);
    select_move_destroy_remove(Targets);
    sleep(delay))),
 (hop_node(any);
  repeat(
   Global = merge(hop_nodes(all); Targets);
   stay(hop_nodes(all); merge(Targets, Global));
   move(any_neighbor))))
```



a *b*

Figure 12 – Supplying the swarm with higher-level migrating global awareness

The overall consciousness of the swarm can always remain operational regardless of the varying number of interacting units in it, up to a single unit of its possible final reduction.

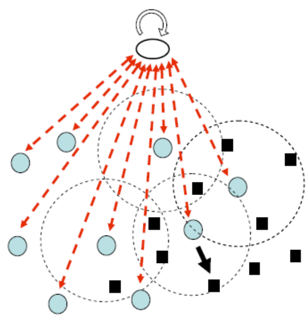


Figure 13 – Using separated external global awareness

Swarms with outside activated eternal global awareness and consciousness

This external super-consciousness can also reside outside the swarm body operating within other systems at any terrestrial or celestial distance from the swarm, as follows (see also Fig. 13). This outside consciousness can also be independent of the swarm organization and collect what swarm units can see directly and immediately as below. It can also use more powerful external observation capabilities (like advanced radars) for overseeing the targets which may reside in the expected operational area or well beyond it.

```
nodal(D1 = distance, Targets); frontal(Global);
parallel(
 (hop_nodes(all);
  repeat(
```

```
    extend(Targets) = search(D1);
    select_move_destroy_remove(Targets);
    sleep(delay))),
 repeat(
   Global = merge(hop_nodes(all); search(D1));
   hop_nodes(all); merge(Targets, Global)))
```

5. SGT and some known mental concepts

The discussed SG paradigm can be potentially linked to higher and more general concepts (like [44–56]) than traditionally used for the system descriptions, with some of them following. *Understanding* is a psychological process related to an abstract or physical object, such as a person, situation, or message whereby one is able to use concepts to model that object. Understanding is a relation between the knower and an object of understanding [44]. Also, understanding the problem is often the main part of its solution [45, 46]. *Perception* is the organization, identification, and interpretation of sensory information in order to represent and understand the presented information or environment [47]. *Self-Awareness* and *Mental Perception* go even higher [48]. At the highest level is the concept of Consciousness [49], with many theories and fantasies of what it actually means, can even exist outside the head [50] or pervade the Universe [51], also the relation of consciousness to space [52, 53]. The soul [54] within many religious, philosophical and mythological traditions is the incorporeal essence of a living being. It is to comprise the mental abilities of a living being: reason, character, feeling, consciousness, memory, perception, thinking, etc. Depending on the philosophical systems, a soul can be either mortal or immortal [54], and such guesses like its possible separation from the body [55], when it enters the human body, or where it resides [56] are even fantasized too.

The original author's concept called WAVE [4, 57–60] was invented keeping in mind these higher mental concepts which were in some sense closer to the notion of "soul". This was in opposition to The Society of Mind by Marvin Minsky [61] which portrayed the human mind as a society of tiny components, or agents, themselves mindless, together like a mosaic; their frequent interactions supposedly forming what was called "intellect".

6. The relation of the SG concept to the pattern theory

All SGL active recursive scenarios, including those in this paper, actually behave as self-evolving and self-matching patterns, which could be further inherited and used as a basis for more complex applications. The word "pattern", however, is generally considered one of the most fundamental and universal concepts in many areas of human activity [62–65]. For example, it may express the following:

- a model or plan used as a guide in making things;
- a regularity in the world, in human-made design, or in abstract ideas;
- a way the brain creates mental templates;
- a key to creating a reusable, impactful design system;
- uncovering the fundamental principles of nature;
- advancing models of design research, practice, and pedagogy;
- a person or thing considered worthy of imitation or copying;
- something representing a class or type, example, sample;
- a «skeleton» that organizes the parts of a composition;
- things existing in nature as well as in the designed objects;
- an overview of speech recognition, image analysis, and computer vision;
- germs of a universal theory of thought in opposition to the terms of logic.

The next stage of the current SGT-based project plans to put the pattern-based concept at the forefront for detailed investigation of its meaning, expression, and extended application in the areas ranging from mathematics and technologies to mental behaviour. The main components of this evolving project may be as follows:

1. The concept of pattern and its universal nature.
2. Recursive and distributed Spatial Grasp patterns.
3. Pattern optimization.
4. Self-evolving intelligent patterns.
5. Pattern-recognition methods under the SG model.
6. Pattern-matching methods under the SG model.
7. Using SG patterns in different areas.

7. Conclusions

Having described the basics of the developed SG model and technology, the paper showed examples of expression in SGL of such known gestalt theory concepts as the Law of Proximity, Law of Good Gestalt, and Law of Figure and Ground, extending the investigations revealed in previous SGT-related publications. This could allow the high-level recursive SGL scenarios directly see, recognize, and assess complex visual images in fully distributed environments. It then demonstrated how to organize in SGL a global vision and awareness for mobile multi-component systems acting collectively as swarms in distributed environments, with each unit originally seeing only a part of the operational area. Adding to them a sort of global vision can drastically improve the swarm's performance, which can be provided by SGT in a variety of ways -- from embedded internal to self-spreading external. It was mentioned how SGL and SGT can be linked to higher mental concepts like perception, consciousness, and even soul. Was also explained the direct relation of SGT to such general philosophical, theoretical and practical concept as pattern, with the current project's activity developing in this area too. Further plans include a detailed investigation and application of the concept of pattern, which should result in extended publications in this area, including a new book.

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