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Review Article

Holistic Spatial Management of International Security

Peter Simon Sapaty*
Institute of Mathematical Machines and Systems National Academy of Sciences, Glushkova Ave 42, 03187 Kiev, Ukraine

***Corresponding author:** Peter Simon Sapaty, Institute of Mathematical Machines and Systems National Academy of Sciences, Glushkova Ave 42, 03187 Kiev, Ukraine

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Abstract

The purpose of this paper is to introduce a novel high-level distributed processing and control approach capable of finding runtime solutions for irregular, crises and security problems emerging any time and in any points of the world. The offered model and technology are based on spatial matching of distributed dynamic systems by self-navigating, self-replications and self-modifying spatial patterns expressed in a special high-level recursive language. It has been found that the described approach, previously prototyped and tested in different countries on numerous civil and defence applications, may be especially effective for solving crises and security problems covering large territories. Based on free movement of recursive scenario code in distributed spaces with implanted communicating interpreters of the scenario language (with may account up to millions to billions of nodes and working without any central resources), the approach has no limitations for solving urgent world problems. The technology basics can be easily implemented in a short time and by a small group of system programmers even within traditional university environments, as was done for its previous versions in different countries. The approach also has high social implications and value which resulted in a new book on holistic spatial management of large social systems, cited in the current paper. The technology is unique so far, with its holistic and gestalt-based solutions, grasping spatial environments directly, being often hundreds of times shorter than under other models and languages, as most of traditional system routines are hidden inside intelligent and networked automatic language interpretation.

Keywords: United Nations; International security; World conflict areas; Spatial Grasp Technology; Networked language interpretation; Mobile spatial scenarios; Parallel and distributed control

Introduction

International security, also called *global security*, refers to the amalgamation of measures taken by states and international organizations to ensure mutual survival and safety [1]. These measures may include military actions and diplomatic agreements such as treaties and conventions. Security policy is more than defence policy, more than military policy, more than a policy aimed at being prepared for war; security policy is also *aimed at avoiding war* [2]. Security policy embraces domestic security, economic development policy, and policy for influencing the international system so as to create a peaceful environment, regionally as well as globally. The world is entering its most dangerous chapter in decades [3], where the sharp uptick in war over recent years is outstripping the ability to cope with consequences. From global refugee crisis to the spread of terrorism, the collective failure to resolve conflict is giving birth to new threats and emergencies. Even in peaceful societies, the politics of fear is leading to dangerous polarization.

Conflicts are often spreading from local no nonlocal to international to global, covering large distributed spaces, and it is becoming more and more difficult to prevent, control, and stop them by traditional centralized agencies and resources, also existing measures and technologies. *Something in a much broader and more powerful scale is needed* for maintaining national, international and global security, which could operate holistically, globally, and spatially. And this is *the aim and main contents* of the current publication.

The rest of this paper is organized as follows. Section 2 provides examples and discusses security issues in concrete areas including disease epidemics, world religious diversity with potential tensions, environmental dangers, refugee crises, armed conflicts, terrorism, etc. Section 3 briefs some existing international security bodies and measures like United Nations, Security Networks, and security oriented technologies. Section 4 describes basics of the developed Spatial Grasp Technology, SGT, with its self-evolving spatial patterns, Spatial Grasp Language, SGL, and its networked interpreter. Section 5 provides security-oriented application examples written in SGL, like finding suspects worldwide, controlling and impacting the spread of a conflict, and distributed simulation of territorial conquest by competing forces. Section 6 concludes the paper while providing hints for a quick technology implementation, and the References include information on the cited review sources and previous technology publications and applications.

Security Issues in Concrete Areas

Below are brief excurses into the world areas with potential dangers to international security, all such dangers having massive, spatial, and distributed nature, and requiring quick and global reaction on them.

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Figure 1: Ebola outbreak in Africa with air traffic connections to the rest of the world.

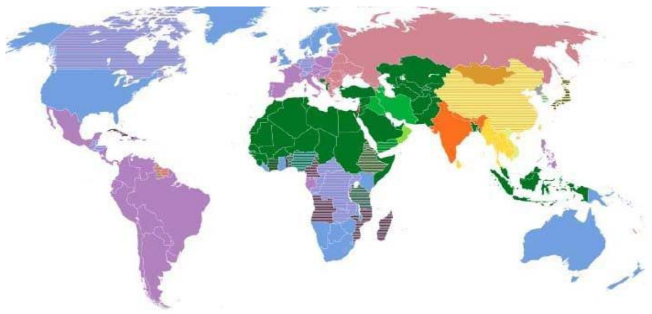

Figure 2: World colour-coded map denoting different religious affiliations.

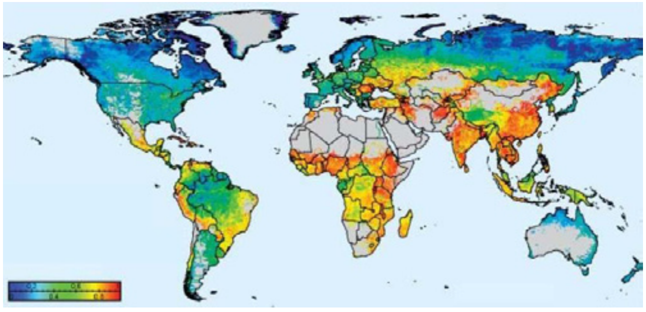

Figure 3: World map expressing global threats to human water security.

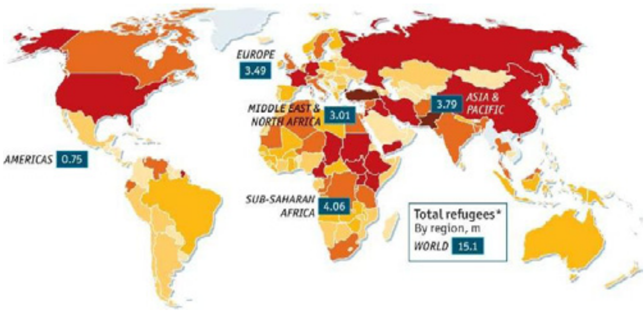

Figure 4: Example of 2015 world map of refugees.

Epidemics

The 2014 West African Ebola Outbreak [4] was one of the largest and deadliest recorded in history. The affected countries, Sierra Leone, Guinea, Liberia and Nigeria, had been struggling to contain and mitigate the outbreak. The ongoing rise in confirmed and suspected cases, 2615 as of August 2014, was considered to increase the risk of international dissemination, especially because the epidemic was affecting cities with major commercial airports (Figure 1). For historical reasons, all these countries had strong ties with European countries. Nigeria, being the most populous country in West Africa with more than 166 million people, was especially connected to the rest of the world.

World religious diversity

Influence of different religions on the world security should not be underestimated [5]. Historically, religious war [6] or holy war was a war primarily caused or justified by differences in religion. In the modern period, debates are common over the extent to which religious, economic, or ethnic aspects of a conflict predominate in a given war. The nature of the religious dimension of international conflict, which is sometimes neglected, is often misunderstood, and frequently exaggerated. No major religion has been exempt from complicity in violent conflict, but religion is often not the sole or even primary cause of conflict. With so much emphasis on religion as a source of conflict, the role of religion as a force in peacemaking is usually overlooked. In Figure 2, the main world religious affiliations [7] are shown in different colours (as of 2011) without further details, just to highlight the existing religious diversity worldwide.

Environmental dangers

Environmental security [8] considers the abilities of individuals, communities or nations to cope with environmental risks, conflicts or limited natural resources. For example, climate change can be viewed a threat to environmental security. Human activity impacts CO_2 emissions, influencing regional and global climatic and environmental changes and thus agricultural output. This can lead to food shortages causing political debate, ethnic tension, and civil unrest. For example, protecting the world's freshwater resources [9] requires diagnosing threats over a broad scale, from global to local. It has been found that nearly 80% of the world's population is exposed to high levels of threat to water security, as shown in Figure 3 in colours (from blue as lower to red as higher). Massive investment in water technology enables rich nations to offset high stressor levels without remedying their underlying causes, whereas less wealthy nations remain vulnerable.

Refugees crises

Refugee crises [10-12] for the last years have essential impact on international security. A refugee is a displaced person who has been forced to cross national boundaries and cannot return home safely. Such a person may be called an asylum seeker until officially granted refugee status if they formally make a claim for asylum. By the end of 2016, 65.6 million individuals were forcibly displaced worldwide as a result of persecution, conflict, violence, or human rights violations. In 2017, the total number of forcibly displaced persons was 68.5 million. From them, official total refugee population number was 25.4 million. An example of world map of refugees for June 2015 is shown in Figure 4, with darker colours indicating higher refugee levels [12] (sources: UNHCR, Migration Policy Institute, Refugees International, press

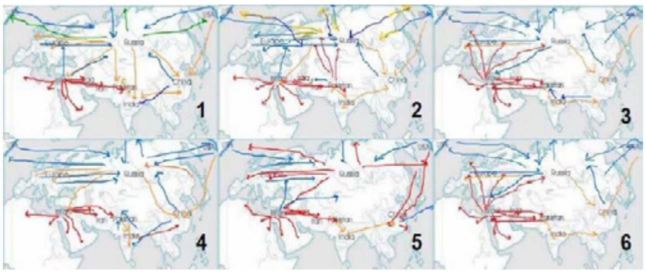

Figure 5: Six hypothetic escalation nuclear scenarios.

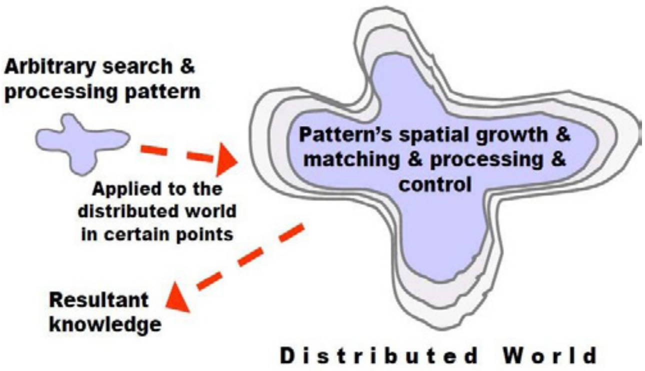

Figure 6: Spatial pattern growth & coverage & matching.

reports).

Armed conflicts

The main situations of armed violence (in 2017) have been described and discussed in [13] that amounted to armed conflicts in accordance with definitions under International Humanitarian Law (IHL) and International Criminal Law (ICL). In any event, the existence of an armed conflict was generally limited to the areas where the parties to the conflict were conducting hostilities against each other, although armed conflicts may potentially evolve into global ones. The most terrible could be nuclear war [14] theoretically involving most or all nuclear powers releasing a large proportion of their nuclear weapons. Fig. 5 depicts schemes copied from [15] and related to six hypothetical escalation scenarios which may be spiralling to the world's nuclear war. These pictures (of 2007, already outdated politically and semantically) are used here only to show the possible spatial world dynamics under such or similar conflicts and which may serve as a hypothetical testbed for the crisis management technology discussed in this paper.

Other areas

Many other areas can be named containing potential threats to international security [16-21], and especially *terrorism* [18], which in the broadest sense is the use of intentionally indiscriminate violence as a means to create terror among masses of people or the fear to achieve financial, political, religious or ideological aim. The global terrorism index for 2016 can be found in [20].

International Security Bodies and Measures

There are many such bodies and measures worldwide, due to highest importance of national and international security issues, with few of them mentioned in this section.

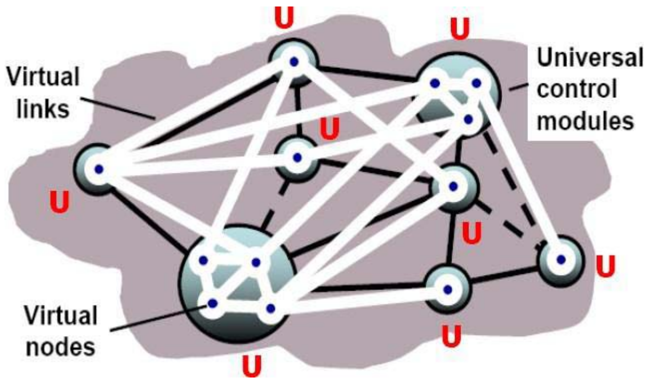

Figure 7: Creating distributed knowledge infrastructures.

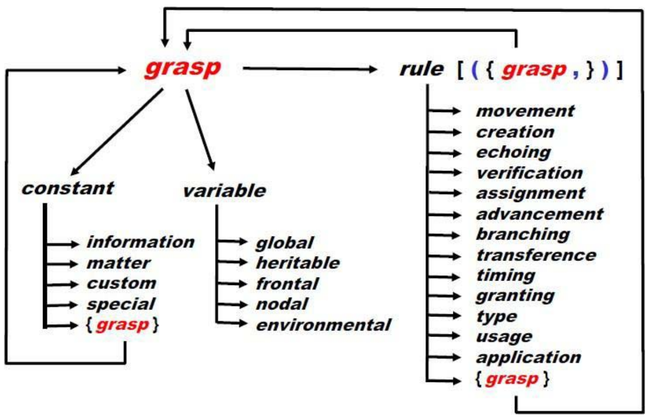

Figure 8: SGL recursive syntax.

United nations

Saving succeeding generations from the scourge of war was the main motivation for creating the *United Nations*, UN [22]. Since its creation, the UN has often been called upon to prevent disputes from escalating into war, or to help restore peace when armed conflict does break out, and to promote lasting peace in societies emerging from wars. UN *Security Council* [23] is the organ with primary responsibility for the maintenance of international peace and security. When a complaint concerning a threat to peace is brought before it, the Council's first action is usually to recommend to the parties to try to reach agreement by peaceful means. In some cases, the Council itself undertakes investigation and mediation. It may appoint special representatives or request the Secretary-General to do so or to use his good offices. It may set forth principles for a peaceful settlement.

Security network (ISN)

The International Relations and Security Network (ISN) [24] was an open access information service located at ETH Zurich. Its mission was to facilitate international relations (IR) and security-related dialogue and cooperation within a network of organizations, professionals and students, and to provide open-source research tools and materials in accessible ways. ISN collated and shared IR and security- centered content from numerous partners throughout the world and maintained a freely accessible multimedia library that provided tens of thousands of IR and security-related materials. In

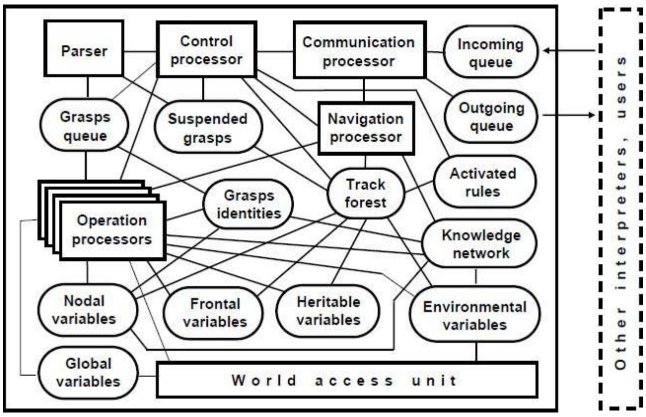

Figure 9: SGL interpreter organization and main components.

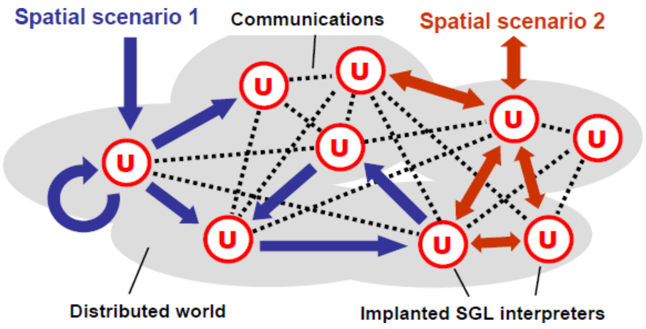

Figure 10: SGL interpretation network as a universal spatial machine.

2016, the ISN was fully integrated into its parent organization, the Center for Security Studies, CSS [25]. The ISN was also a co-organizer of the Swiss-sponsored International Security Forum (ISF), which is a large conference held every two years in Geneva and Zurich on a rotating basis [26].

New technologies

The impact of new technologies on peace, security, and development is crucial [27]. It has been argued that we are now in the fourth industrial revolution, where a fusion of technologies is blurring lines between the physical, digital, and biological spheres. The new technologies include everything from the Internet to drones to big data, and the potential applications of these technologies are rapidly expanding. In the 2020, 60% of individuals are expected to be actively using the Internet. Many organizations are developing security-oriented technologies like, for example, *International Security Networks* [28], which is a leading manufacturer of complete security solutions, providing the leading software suite for gated communities.

Spatial Grasp Technology (SGT)

We are briefing here the developed and patented high-level networking control and processing technology [29-46] tested and prototyped in different countries, which may be suitable for runtime dealing with urgent international crises and security problems. It can potentially start in any world points and cover the whole universe with efficient spatial solutions.

Figure 11: Spatial worldwide search for individuals with the return of data found.

Self-evolving spatial patterns

Within 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 traditional program, sequential or parallel. This pattern, written in a high-level Spatial Grasp Language (SGL) and expressing top semantics of the problem to be solved, can start from any world point. It then spatially *propagates, replicates, modifies, and matches* the distributed world, as shown in Figure 6.

The self-spreading & matching patterns can create *knowledge infrastructures* arbitrarily distributed between system components (humans, robots, sensors, other systems, etc.) as in Figure 7, where communicating SGL interpreters are shown as universal control modules U. These infrastructures, which may be left *active*, can effectively support or express *distributed databases, command and control, situation awareness, autonomous decisions*, as well as *any other* existing or hypothetical computational and control models.

Spatial grasp language (SGL)

SGL allows us to *directly move through*, observe, and provide any actions and decisions in fully distributed environments (whether *physical, virtual, executive, or combined*). It has universal recursive structure, shown in Figure 8, capable of representing any parallel and distributed algorithms operating *on, over*, or *in* spatially scattered data or other distributed systems.

An SGL scenario develops as *parallel transition* between sets of progress points (or *props*), with self- modified and self-replicating scenario code freely moving in distributed spaces. Starting from a prop, an action may result in new props (which may be multiple). Each prop has a resulting value, which may be arbitrarily complex, and resulting state (one of: *thru, done, fail,* and *abort*). Different actions may evolve independently or interdependently from the same prop, splitting and parallelizing in space. Actions may also spatially succeed each other, with new ones applied sequentially or in parallel from the props reached by previous actions.

Elementary operations can directly use states and values of props reached by other actions *whatever complex and remote* they might be. Any prop can associate with a position in physical, virtual, executive or combined world. Staying with world points, it is possible to directly access and impact local world parameters in them. Overall organization and control of the breadth and depth space navigation and coverage is provided by SGL rules, which may be nested. These

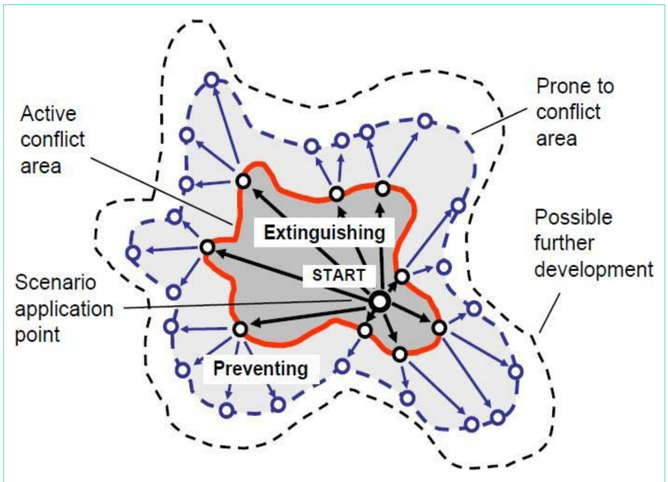

Figure 12: Spatial coverage and impact of the evolving distributed processes.

rules, for example, can be as follows.

- Elementary arithmetic, string, or logic operation.
- Hop in a physical, virtual, execution, or combined space.
- Hierarchical fusion and return of (remote) data.
- Distributed control, both sequential and parallel.
- A variety of special contexts for navigation in space, influencing embraced operations and decisions.
- Type or sense of a value or its chosen usage, guiding automatic interpretation.
- Creation or removal of nodes and links in distributed knowledge networks.
- A rule can be a compound one, integrating other rules; it can also be defined as a result of operations of arbitrary complexity.

Working in fully distributed physical, virtual or executive environments, SGL has different types of variables, called spatial, effectively serving multiple cooperative processes:

- **Heritable variables:** Starting in a prop and serving all subsequent props which can share them in both read & write operations.
- **Frontal variables**: Transferred on wavefronts between consecutive props and replicated if multiple new props emerge.
- **Environmental variables:** Accessing different elements of physical and virtual words when navigating them, also certain parameters of SGL interpreter.
- **Nodal variables:** A temporary property of world nodes, accessed and shared by all activities associated with these nodes.

These types of variables, especially when used together, allow us to create flexible and robust spatial algorithms working in between components of distributed systems rather than in them. Such algorithms can replicate, spread and migrate in distributed environments (partially or as a whole), always *preserving global integrity and control*. To simplify SGL programs, some traditional abbreviations of operations and delimiters can be used too, as substituting certain rules, but altogether always remaining within the general syntactic structure shown in Figure 8.

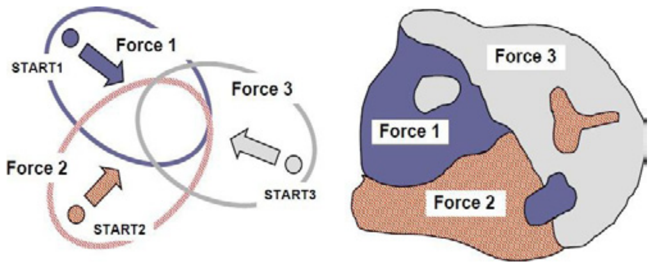

Figure 13: Spatial simulation of the territory coverage by conflicting forces.

SGL networked interpreter

The SGL interpreter consists of a number of specialized modules handling and sharing specific data structures, as in Figure 9.

The interpreters can communicate with each other, and their distributed network can be mobile and open, changing the number of nodes and communication structure at runtime.

The backbone and nerve system of the distributed interpreter is its dynamic *spatial track system* with its parts kept in the *Track Forest* memory of local interpreters. These are logically interlinked with similar parts in other interpreter copies, providing altogether *global control coverage*. The distributed track structure enables for hierarchical and horizontal control, also remote data and code access, with high integrity of emerging parallel and distributed solutions achieved *without any centralized resources*.

Dynamically created track forests spanning the systems in which SGL scenarios evolve are also used for supporting spatial variables and echoing & merging control states and remote data, while self-optimizing in parallel echo processes. They also route further grasps to the positions in physical, virtual, executive or combined spaces reached by the previous grasps, uniting them with frontal variables left there by preceding grasps.

The distributed SGL interpreter may have any number of communicating nodes, *up to thousands to millions to billions*, effectively *converting the whole world into a universal spatial machine* operating under spreading intelligent scenarios. Any number of such scenarios can operate simultaneously (cooperatively or competitively) while starting at any time and from same or different world points (Figure 10).

Being very compact (by the gained experience of implementation on different platforms) the U copies may be integrated with (or implanted into) any existing systems, popular media and email including. They can also be *concealed* if to operate in hostile environments, allowing the latter to be analyzed and impacted in a stealth manner.

In the next section, we will be showing fully distributed and parallel solutions in SGL for exemplary problems that may relate to international security, showing their compactness and capability of effectively working in a global, worldwide scale.

SGL Application Examples

For the following scenarios, we will be first providing their natural language descriptions with key words marked in bold, and then showing formal versions in SGL where the same words are identifying corresponding operations or parameters in their bodies, thus showing the transition from informal to formal descriptions, with the latter capable of direct execution by the technology offered.

Finding suspects worldwide

Imagine we have to find detailed information about individuals belonging to some *Group* indentified by specific group's features, with the group historically originating in *START* position represented by certain physical or virtual address. When staying in this position, the group members can be found by a match of the group's features with *local_databases*. The latter may, however, fail to have records on some or all individuals sought, but their traces may exist in *local_security* systems checking, for example, movement of passengers at air and sea ports or on roads, etc. If such traces exist and lead to *Other* world locations, it will be reasonable to search both data and security records at the other points too, and so on. This combined database & security checking may, in principle, spread and cover the whole world, and in parallel. The found concrete match in different world points can be collected with its return (along with exact whereabouts of individuals) to the *START* point with output there.

This scenario can be directly expressed in SGL in a compact manner, as follows, with its possible spatial evolution shown in Figure 11.

```
hop_first(START);
nodal(Other);
frontal(Group) = features;
output('Records found worldwide:' &&
     repeat(return(match(Group, local_databases)),
          Other = traces(Group, local_security);
          hop_first(Other)))
```

Answer in the START point may be as follows:

Records found worldwide: *match_1, match_2, …, match_m*

Controlling and impacting the spread of conflict

Imagine there is evolving and spreading phenomenon in some region (like, for example, ethnic or military conflict). And we want, beginning from some node *START* determined as being inside this conflict, to spread our search through the conflict area, via *neighbors* of the reached nodes, and in parallel, with trying in each new node where its *STATE* returns *active* to *impact* (like extinguish, or *quench*) the conflict there. After reaching boundary of the activity zone, we may decide to continue spreading further with trying to prevent the conflict appearance in new nodes if their *STATE* still indicates as prone to the conflict. After reaching boundary of conflict *prone* zone, we may want to collect and bring back coordinates, or *WHERE*, of all nodes lying on this boundary and *output* them as indication of the beginning of totally safe area. All this can be expressed in SGL in a compact form as follows (see also Figure 12), where operation *hop_first* allows for reaching new nodes only once, thus preventing possible cycling.

```
hop_first(START);
output('Conflict prone boundary:' &&
  repeat(or_sequence((STATE == active; impact(quench)),
                     (STATE == prone; impact(prevent)),
                     done(WHERE));
     hop_first(neighbors)))
```

The answer in the *START* node may be as follows:

Conflict prone boundary: *x1_y1, x2_y2, x3_y3, …, xm_ym*

For a simplified variant of this scenario, like only spreading throughout the active conflict zone with doing nothing at nodes reached but providing output of the coordinates of nodes on the zone's boundary, we may write:

```
hop_first(START);
output('Active conflict boundary:' &&
    (repeat(STATE == active; hop_first(neighbors));
     WHERE))
```

The answer in START this time will be as:

Active conflict boundary: *x1_y1, x2_y2, x3_y3, …, xn_yn*

Another variant of this scenario by which coordinates of all nodes reached inside the active conflict area are to be collected, returned, and output, may look like follows:

```
hop_first(START);
output('All active conflict nodes:' &&
    repeat(STATE == active; free(WHERE),
        hop_first(neighbors)))
```

The answer in START position now will be as:

All active conflict points: *x1_y1, x2_y2, x3_y3, …, xk_yk*

The scenarios presented above may also relate to other types of evolving phenomena, like spreading of diseases, where inside the active zone we may use strong, say, virus killing drugs and outside it, within the disease prone zone, prophylactic ones. Other similar scenarios may be used for forest fires, flooding, famine, etc.

Distributed simulation of territorial conquest

Imagine we have different opposing forces, let them be three, and which have individual strengths identified by *data1, data2, data3,* which are starting, correspondingly, in positions *START1, START2,* and *START3*. Each *Force* tries to conquer and cover the whole *Area* defined by coordinate limits while competing with other forces on the same territory. The resultant space coverage by particular force can depend on combination of the force's strength, *QUALITIES* of this point of the region, which may include ethnicity and acceptance of this *Force* by local population, also take into account its previous occupation which may be by a different Force (kept in its

CONTENT). The changing from one particular occupation force to another may not be acceptable by locals, and the fixed *Level* from the previous occupation should be taken into account too. So Real power needed to occupy this point by the current *Force* may differ from the individual strength of this force. As a result, we may have a complex occupation map of the *Area* similar to the one shown in Figure 13 (a bit similar, say, to what we may see now in Syria), with corresponding SGL scenario code provided below. The previous versions of the technology were efficiently used for similar tasks to this one, like distributed interactive simulations of large military systems [43-46].

```
frontal(Force, Area = limits);
nodal(Real, Level);
branch((hop(START1); Force = data1),
         (hop(START2); Force = data2),
         (hop(START3); Force = data3));
repeat(Real = power(Force, CONTENT, QUALITIES);
        Real > Level; Level = Real; CONTENT = Force;
        hop(neighbours, Area))
```

To list coordinates of all nodes, say, marked with Force1, we may write:

```
output('Force1:' && (hop_nodes(Area); CONTENT == data1; WHERE))
```

The answer in this scenario starting position (which can be any one, including outside the system) may be as follows:

Force1: *x1_y1, x2_y2, x3_y3, …, xn_yn*

Any other scenarios for solving nonlocal to global conflict problems by the world coverage with self- spreading, self-matching, and self-replicating high-level SGL code can be readily offered too. No centralized resources are needed for such solutions at all, and moreover, no copying of the huge and distributed information before its analysis either, with spatial solutions found directly where multiple data pieces and their relations reside.

Conclusion

The offered approach can believably make useful contribution to the international and global security, allowing complex problems to be solved in distributed environments without vulnerable centralized resources, while operating in a flexible spatial matching, flooding, or even virus-like mode. The technology can be incorporated within UN or other international bodies as a special global security technique for predicting, preventing, avoiding, and analyzing local and global crises in real time and often even ahead of it. The main difference of the ideology and technology offered is that it directly operates on surfaces of large distributed worlds expressing (grasping) only top semantics and key decisions of the problems to be solved while hiding most of traditional system organizational routines (up to 99 percent) inside intelligent and automatic language implementation. This allows us to have highly compact, holistic, gestalt-like solutions that can be created on the fly when timely reacting on rapidly changing and asymmetric situations.

SGL has very simple recursive syntax of its core subset, which can be easily implemented in a short time and even within usual university environments, as was done before in different countries for previous technology versions, with the author usually serving as team's playing coach, top scenario programmer, and supervisor of related MSc and PhD projects. Implementation of SGL interpreters can also be done with their effective embedment into any existing internet, popular media, robotic, and command and control systems. The full language version can be readily implemented for extended applications too, with the author always ready to help with this.

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