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CCIFQ INTERVIEWS

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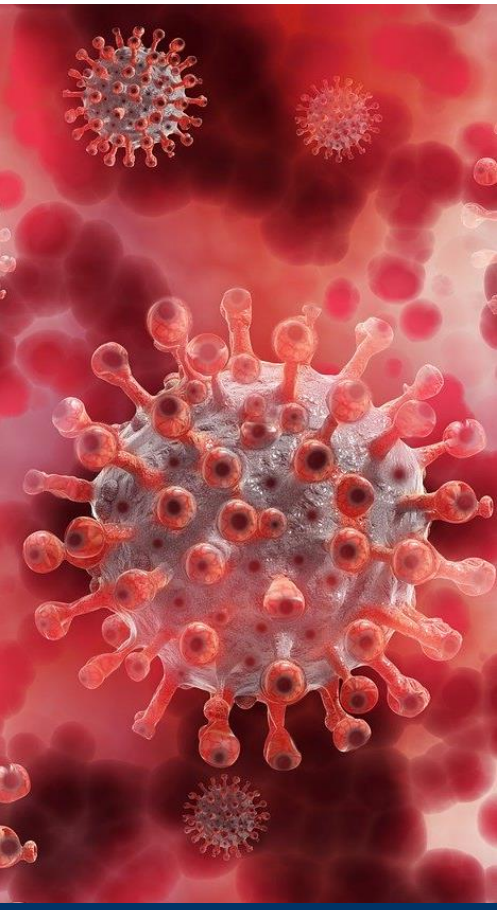
*On **Wednesday 15th of July**, ADGS Team will demonstrate live the capabilities of **PANDEXIT**, a pandemic simulation software developed entirely in Qatar (register here). The model runs billion of calculation to simulate the entire population of Qatar, places and transportation, and shows the expected results of the current government policy response.*

Tell us first about ADGS, please.

ADGS has been built around a franco-qatari friendship and partnership to create a Deep Tech Company in Qatar, researching and developing Artificial Intelligence applied to human language, Behavioral Biometrics and Emergent Behavior. We could say that the surprising ADGS achievements come from an extraordinary team working in perfect harmony.

BIOGRAPHY

Educated as a fighter pilot in the French Air Force, has 29 years of experience in technologies, security, software engineering, database systems and business re-engineering. Christophe has founded, developed and managed several successful hi-tech companies in the U.S and Europe.



"(...) WITH PRECISE AND FAITHFUL DATA, AS WELL AS ENOUGH COMPUTING POWER, UNCERTAINTY CAN BE REDUCED, AND MANY INITIALLY UNEXPECTED OUTCOMES CAN BE DISCOVERED AND EXPLAINED"

What is PANDEXIT in two sentences?

PANDEXIT is a tool for helping informed decision makers visualize and understand the possible outcomes of alternative scenarios by simulating, with a realistic agent-based model, the spread of the pandemic inside a country or region under different policies and conditions. PANDEXIT is not a real time tracking system, nor another refined statistical model; it is a detailed one-to-one simulation of every person in the territory under consideration and his or her whereabouts.

How is it useful for a government fighting a pandemic?

Decision making is not about the past. It is about the future, and the future cannot be known with certainty. However, with precise and faithful data, as well as enough computing power, the uncertainty can be reduced, and many initially unexpected outcomes can be discovered and explained. You can see that every day in the weather forecast. It cannot tell you exactly what the temperature will be tomorrow, but you can get a very good approximation which might save you some inconveniencies. PANDEXIT is useful for governments fighting a pandemic as it allows them to estimate the future outcome of policies that are being considered but not yet implemented in a risk-free way, based on the specific characteristics of the territory and not generalizations which might not apply.

How does it work?

Inside PANDEXIT, every simulated person is a small program that goes through its daily life as we would in the real world. It wakes up at his home, commutes to his job, goes to the supermarket a few times a week, has friends and family that he visits with a certain frequency, sometimes goes to the church or mosque to follow his religious practices. Every one of these places is represented geographically inside PANDEXIT, and so are the transport means used to reach them by the agent. Millions of these simulated persons move around the virtual world, following (and sometimes defying, or forgetting to enforce) the policies set up by the administrator, such as forcing them to use masks in public, checking temperature at shop entries, restricting travel from some areas to others, etc. Some of these agents are infected and transmit the pandemic around as their real-world counterparts.

What is an agent-based model?

An agent-based model is a class of computing models which simulate the actions and interactions of a set of autonomous agents, with the objective of understanding and predicting the behavior of a system as a whole. This stands in contrast to a statistical or dynamic model, where the persons are aggregated in groups like susceptible, infected, and recovered, not considered individually. Specifically, for PANDEXIT, this means every person in the territory under consideration is simulated by a small program that follows his or her daily routine.

What kind of data do you use?

The model of PANDEXIT contains three types of entities: persons, places, and transport. Places are characterized by their geographical coordinates, which kind of place it is (as in office, hospital, shopping centre, small shop, church, etc.), and its size. Transports are characterized by their type (car, metro, bus, etc.),

"(…) OUR FIRST PROTOTYPE WAS COMMISSIONED BY THE MINISTRY OF DEFENSE OF ARGENTINA TO EVALUATE THE SPREAD INSIDE THE ARMED FORCES AND THE MILITARY SCHOOLS."

their size, and to which line or route they belong. Persons are the most complex entities in the system; they are characterized by their age, nationality, shopping habits, transport strategy, etc. It is also needed to link these three types of entities. Every person has a home, most have a job to attend (or a school if they are children), a preferred set of shops they use frequently, a list of friends they visit with certain frequency, possibly a family, and some social gatherings they enjoy. This is the baseline of data needed, but some of it can be generated using demographic models. For more complex scenarios, obviously more data is needed. Say, if you want to understand how different businesses are affected or contribute to the spread, we will need to separate the places by category.

Do you have to enter each person's data one by one?

You do not need to actually do a manual data entry person by person, place by place, transport by transport. The data to feed the simulation can be imported from existing databases the government already has, and the missing information can be estimated with demographic models. Of course, the more actual data representing the real world you can provide, the better the results of the simulation will be.

Does PANDEXIT conflict with privacy?

No, it doesn't. PANDEXIT is an agent-based simulation tool, not a real time tracker. It is not following you around. Inside the simulation there is an agent that has your age and nationality, lives roughly where you live, and roughly follows your daily routine, but there is no live synchronization between the simulated agent and you. The data required to represent your digital surrogate is very similar to one produced by a census.

Can PANDEXIT compare the rate of infection in different communities?

Yes, it can, but with a proviso. If you feed the simulation with the aforementioned data for different communities, you can compare the outcome for each of them. The basic reproduction number, R0, that is mentioned everywhere in the news nowadays is not a property of the pandemic per se, but a resultant of the characteristics of the pandemic and the community together. Even if the virus is the same, when infecting a more aware population that can respect and follow accurately the safety guidelines, its basic reproduction number will be much lower than in the presence of generalized risky behavior. PANDEXIT, if fed with enough precise data, can capture these underlying conditions and give a rough prediction of the relative outcomes in different communities. But there is a proviso. We are talking here about the comparison of relative outcomes, not scenarios valid in the absolute sense. There are currently too many uncertainties for anybody to claim absolute accuracy. If PANDEXIT predicts 5000 deaths in a community that does not mean that will not be 4900 or 5100, but if it predicts double that number for another one, it is surely at much higher risk. As an example of modeling specific communities, our first prototype was commissioned by the Ministry of Defense of Argentina to evaluate the spread inside the armed forces and the military schools.

Can PANDEXIT predict the future number of COVID-19 cases?

No, it cannot. Nobody can, and you should not trust anybody saying they

"PANDEXIT CAN PREDICT SUBSEQUENT WAVES OF THE PANDEMIC ARISING FROM POLICY CHANGES (...), OR FROM CHANGES IN PEOPLE'S BEHAVIOR"

can. There are currently too many uncertainties for anybody to claim absolute accuracy. Models, whether statistical, dynamic, agent-based, or of any other kind, are tools for decision making and not crystal balls where you can behold an immutable future. Changes of policy or behavior can make a huge difference, as you can see by comparing how different countries are being affected. That being said, the prediction of the future cases that PANDEXIT generates can be an excellent indicator of relative outcomes, as if a certain community, nationality, economic sector, or region, is more at risk than another.

Can PANDEXIT predict subsequent waves of the pandemic?

PANDEXIT can predict subsequent waves of the pandemic arising from policy changes that are premature or mistaken in its aims, or from changes in people's behavior as in massive protests or disobedience of established health policies. PANDEXIT cannot predict subsequent waves that happen because the virus has mutated or evolved. Once again, nobody can, and you should not trust anybody saying they do. The best scientists can do is to keep track of potential menaces, as in the G4 flu strain discovered a few days ago in China, and set up a system of early warnings.

Can PANDEXIT locate the infection foci on a map?

PANDEXIT can display the evolution of the simulation and of the different configured scenarios in a map of the territory under consideration. In the initial stages each carrier can be tracked individually, and when there are too many the infection can be tracked per group or per zone. The simulation is always done on an individual basis, but for visualization it does not make much sense to show one hundred thousand dots in a map. So, the answer is yes, PANDEXIT can locate the infection foci on a map of the territory, and even attribute to a specific place, as in an industry or an airport. But don't forget we are talking about the infection foci inside the simulation, not in the real world.

Can PANDEXIT locate infection hotspots inside a building, like an airport?

Yes, it only needs to be fed with much more detail on the geometry of the place and interactions inside the building. That would be a separate simulation for a specific building, not a part of the countrywide or regionwide simulation. There is simply not enough processing power available to reach such a level of detail for every building in a country

How fast PANDEXIT currently is and how fast could it be and by which means?

How fast PANDEXIT is depends on two parameters: which hardware it is running on, and how many entities and places are included in the simulation. Better hardware will obviously give better performance, up to a linear factor, but there is a limit to how much speedup you can gain in this way. The speed scales slightly sublinearly with the number of entities; in simple terms, this means that doubling the number of entities will make the time it takes to complete a simulation increase to something more than double. For example, in an up to date high end server we are running a six months simulation for Qatar, with its population of 2.8 million, in about ten minutes. We are working on a prototype for the whole country of Argentina, with 50 million people, that is expected to take one or two

"PANDEXIT TAKES PLACES AND TRANSPORTS INTO ACCOUNT AND TREAT THEM INDIVIDUALLY, WHICH A STATISTICAL MODEL DOES NOT CONSIDER"

minutes per day of simulation using the same processing power.

How is it different from statistical models like IHME and SITR?

The only thing it shares is that all are models! In statistical models you consider only groups of people (like susceptibles, infected, recovered, dead, etc.) and the "speed" (we are talking about derivatives, for the informed reader) at which each group spills into the other, which is regulated by a set of differential equations. In an agent-based model you consider every individual person and the conditions of his interactions to track the spread case by case. It is much more computationally expensive while requiring more parameters and input data, but it can show light on complex or specific scenarios that the statistical models cannot apprehend. I am not saying one is better than the other; both have their strengths and weaknesses and are fitted to answer different questions in different time frames.

PANDEXIT model offers a number of other specificities not shared with statistical models:

- PANDEXIT graphically shows the data using a geographic information system (GIS)

- PANDEXIT takes the "small-world" effect into account https://en.wikipedia.org/wiki/Small-world_network)

- PANDEXIT takes places and transports into account and treat them individually, which a statistical model does not consider

- PANDEXIT can change any parameter of the simulation while it runs

Does PANDEXIT take asymptomatic patients into account?

As with any other infectious disease, you must distinguish the symptom severity and the viral load. The viral load, to put it in simple terms, is how many virii you are carrying and is directly related to how much you can spread it to those around you. However, that does not necessarily correlate with your symptoms' severity; you could be very sick and show little symptoms, or have a mild infection yet present with high fever. While the spread depends on the viral load, the ability to detect it without testing depends on the symptom severity. PANDEXIT has integrated this consideration in the model, and the administrator can choose whether to allow asymptomatic and oversymptomatic, at which rate they appear in the simulated population, and several other parameters to better capture their influence.

What if the virus mutates?

The infection model of PANDEXIT is not rigid. It allows for the administrator to define a set of parameters to better correlate it with current knowledge about the virus characteristics. You can change the infection rate, how much it affects older people in comparison with younger people, the death rate when at the hospital or unaided, whether reinfections are possible or not, whether natural and acquired immunity exists and in which percentage of the population, whether immunity fades away and at which rate, to name some of the parameters the PANDEXIT model supports as it stands. We try to keep the values of those parameters in line with the current scientific consensus, but the administrator is free to change them if there is interest in evaluating an alternative scenario.

"IF THE VIRUS MUTATES, PANDEXIT CAN SIMULATE IT TOO. WHAT IS MORE, THIS MAKES THE MODEL NOT RESTRICTED TO CORONAVIRUS ONLY"

Thus, if the virus mutates, PANDEXIT can simulate it too. What is more, this makes the model not restricted to coronavirus only.

Did you correlate PANDEXIT predictions with the evolution of the real situation?

Yes, we have. We are proud to say the comparison of relative outcomes has been accurate, even in view of the remaining uncertainty.

Do you have competitors?

Although a very small number of major countries run agent-based simulations on supercomputers (the TeraGrid in the U.S.), these are more experiments from laboratories and universities than developed and stable products like PANDEXIT. The algorithms at the core of PANDEXIT are so efficient that the requested computing power is far less than these experiments, the costs much lower while the simulation are much easier to setup. Nevertheless, output is equivalent.

Which are the countries using PANDEXIT at this time?

Argentina has been the first country to use PANDEXIT. We have been very recently approached by governments interested to prevent or control a second wave. We can name Singapore, Australia, South Africa and even the Navajo Nation. PM Scott Morrison of Australia explained in "The Guardian" how agent-based modeling and I quote "saved Australia from catastrophe"

Who is the main architect of PANDEXIT?

Although this is a team work, Nahuel Gonzalez is without doubt the main arquitect of PANDEXIT. He is a brilliant Engineer and Researcher on distributed systems, Emergent Behaviour applied to Biology and Human Sciences, Security and Biometrics. He worked with national security agencies, and is a specialist in Artificial Intelligence and Big Data.

https://adgs.com/

Watch the Live demonstration on July 15