

Streaming Swarm of Nano Space Probes for Modern Analytical Methods Applied to Planetary Sciences

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Introduction: The idea described hereby is the concept of Streaming Swarm of Nano Space Probes (SNP) for planetary mission to contain modern analytical methods of nowadays applied to planetary sciences.

However well-known it isn't possible to complete the mission described here nowadays, maybe it is interesting to thinking about it.

Recent technologies allegedly promise fast speed space devices - probes - accelerated by a launch base until to some percent of the speed of light. Some new reports talk about big plans to reach really distant targets [1]. Several hard challenges are standing before those plans and let we try to show some of them.

Author's earlier works described the Nano, Pico Space Devices and Robots (NPSDR) [2-4] and the fleet of Micro Sized Space-Motherships (MSSM) [5] which type or similar devices maybe can fulfill the requirements incidentally.

We have tried to describe methods focus not only horizontally available measuring but on vertical 3D measuring and gives a detailed, layered map on a full spectrum of sensors from electromagnetic waves from radio, through light to micro waves and resonating matter by matter so get seismic and sonar like results to build the complex data of structure of the target from static and dynamic point of view.

When a matter hit a similar matter, the depth of impact can reach maximum six time deeper as the length of the impact object matter in direction of moving. Similar physical law is valid in case of shooting of ammunition from cannons.

We will try to introduce a new streaming type of NPSDR and MSSM to distribute and to handle of them. It will remain a big challenge today to use them when we want to reach a surface of a planetary object.

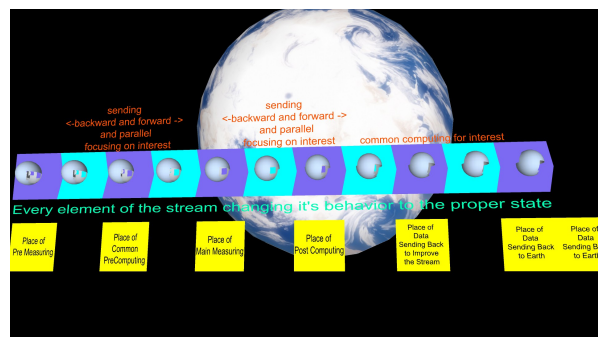
Streaming Swarm of Nano Space Probes as Mission and Instruments Concept [6] described the troubles about accelerating, decelerating, relativistic com-

munications and radiation. Described concepts and possible solutions as communication in Swarm, negative feedback to next part of Swarm.

In case of big abundances of elements of the swarm we can command a special part of the swarm to do a specific job inside a space interval. Let we divide the space into sectors near the target – a moon, planet or star. Particular space intervals demand definite activities. One classical probe is orbiting the target and makes measurements in circulating or near rounding orbit. A high speed streaming swarm couldn't orbit the target. *But we can command the part of them at just the target area to make the same measurements at the same position where classical probe made.* Behaviors of the prepared elements of the flowing swarm are turning into the position dependent program branch and collecting the data. When the element leaves the position turning the behavior to the next program branch, makes new measures and finally transmit all the collected data to a backward to the relay transmitter.

The k^{th} parts of the stream make measurements and start to process the data. According to the results, the k^{th} part of the stream could send feedback to the $k+1^{th}$ part of the stream and so on step by step. It is a theoretical possibility to pinpoint the next new specific measuring according to the preprocessed data. Swarm can send back the whole collected data in one time together to the Earth with the united power of the Stream at cornerstones of mission.

Detailing: During any sensing process in the life, in industry or in research the serial of results are involving the next steps. Streaming NPSDRs have ability to focus some factors which are become important until then and they can emphasize more significant point of view and able to weight out the tasks. For example if we have some useful information about a planet which planet's atmosphere could be clear or cloudy just exactly at that time then the elements of the stream which have arrived earlier can inform the next elements of the stream to set up they sensors to getting ready to use a fitted settings of parameters for the specific measuring. The result must be the same like in case of a single space probe which can turn on and off experiments and they measuring sensors in accordance with the conditions expected. Usually conditions are so rigorous to find the best balance between the available time and electrical power and the importance of significant measuring to achieve the best results for the knowledge.



Additional considerations:

- More independent manufacturers: more independent manufacturers giving benefits during test and demonstration phase and finally the standardization for the best manufacturer.

- Telecommunications e.g. slow and fast; laser or quantum telemetry. Long term and low power consumption for swarm chain communications

- Single or multi purposes - Combined from one task oriented elements of swarm to multi featured surface with different sensors on one element of swarm.

- Task specific altered devices are necessary at different planetary target places.

Target objects:

Planets with magnetic field: Possible target objects in point of view of space physics are magnetic planets, non-magnetic planets.

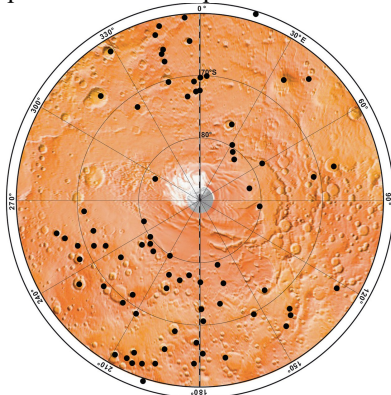
Planetary object size: Requirements are also different in point of view of size, ranging from asteroids, comets to rocky planets through to the gas giant sized planets.

Dusty fields: Dusty places e.g. comets or rings of planets which are around of gas giants usually.

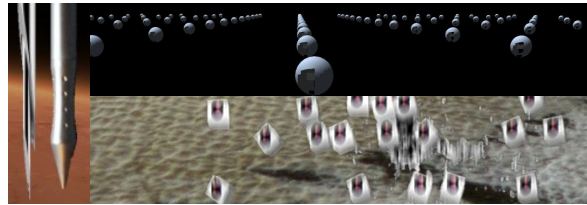
Combined: Gaseous big planets - according to our knowledge - significantly have moons, magnetosphere, dusty halo with particle shower together with huge particle streams and massive amount of individual seemingly random particles may come from even may come even long distances e.g. the distance of Kuiper Belt or Oort Cloud or high radiation galactic particles.

Self-Regenerating: According to last few considerations, some self-regeneration is necessary which is possible in electrical parts of devices according to research of Center for Nanotechnology, NASA Ames Research Center [7] By applying voltage to the gate electrode, the gate dielectric and isolation dielectric are annealed by the high temperature generated by Joule heat, and the damaged device can be recovered to a fresh state.

Possible target: Dark Dune Features in the southern hemisphere of Mars are possible interesting targets.



Conclusion: Streaming swarms gives possibilities to collect data from big fields in one time. The problem is to put enough smart measuring devices in small enough sizes. The redundancy is also coming from the large amount of abundance of the Streaming Swarm of Nano Space Probes (SNP). In case of a realistic streaming swarm mission a weighted distribution of tasks necessary to elaborate during developing and *the whole streaming fleet necessary to behave like one big organization* as one big integrated measuring system and perhaps can be realized as a planetary mission solution with *stream type analytical methods*.

**References:**

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