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Editorial on Mapping Underground Hydraulic Networks by Robotic Navigation System

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Editorial

This navigation algorithm incorporates the method of transferring topographic orientation on geo-reference polygonal, extended to a temporary network of triangles at each vertex; controlled optoelectronic stations are placed by a minimum crew of three collaborative mobile robots that are linked to transfer the geo referenced using an optical target acquisition system composed of a laser distance meter, a phot. A Peripheral Navigation System (PNS) and an Extensive Navigation System (ENS) manage the coordinated master-slave navigation of the robot unit crew (ENS). The first is for rough approach to targets and obstacle avoidance, using ultrasonic [1-3] perception and odometry to detect borders. The second position is for deep search route planning. Reiteration is used to obtain angle and distance measurements that meet the sigma II criterion.

The navigation system software is an application that runs on an operating system that functions as a virtual machine designed specifically for the hardware of the robot units and is installed on a base operating system, which can be a Linux distribution or an IoT equivalent. According to the mapping algorithm that integrates the principles of Tarry, Pledge, and topographic orientation transfer (TORT), the application manages eight hardware subsystems to transform the geometric parameters produced by the metrology system in Eulerian graphs, which are the basis for deep search with which extensive navigation must exhaust network prospecting. Thread agents are used by the OS kernel to interpret, validate, execute, and manage threads between functions.

It receives client requests, segments them, reviews their syntax, looks them up in the dictionary, reviews the types and ranges of parameters, packs them up, and delivers them as inputs for functions, based on the kernel's configuration of the defined task scripts. They are then passed to an executing agent, which invokes each function with the appropriate parameters. At the same time, a thread follower agent monitors the content of the reports of receipt, start, end, and suspension of order execution for both software and hardware. Coverage of the GPS service is frequently lacking in project settings with low-scale economy for underground operations. In such cases, inertial positioning systems on mobile platforms with bearing traction are insufficient to link navigation to an absolute reference, which is required to produce topographic planimetry [4,5] and altimetry suitable for project index.

Mapping is a massive scale and standardized precision process, the costs of which are significantly affected in inaccessible environments of underground infrastructure with conventional methods, so indirect methods are typically used at the expense of precision. The adaptation of topographic orientation transfer to the proposed extensive navigation enables the use of direct methods that separate the uncertainty associated with inertial peripheral navigation from the mapping metrology process. They work together to define the position of topographic objectives by transferring them as nodes to the network map, assigning coordinates by triangulation, and then interpreting the network as a graph. During prospecting, the position of each robot unit can always be determined by triangulation, as the team of robot units looks for discontinuities in the pipeline borders as milestones for node analysis. The SNP reports milestones discovered to the SNE, who classifies and identifies them in the map database before incorporating them with their associated pipelines.

The nodes are characterized by identifying the number and synchronous radial order of the edge connections with the metrology system (modified Pledge criterion), and by using the TORT it is possible to determine which of them the node is entered or exited, and to record the traffic status of each edge (Tarry criterion), which is the basis of the SNE deep search method and the advance criterion. This cyclical process generates a circuit of nodes that, when exhausted, contains all of the network nodes. The prototype robots designed for navigation system testing and validation use a Linux Raspbian distribution V3 processor and Microsoft Windows 10 IoT Core 17661 as the operating system, both of which are implemented as virtual machines. Navigation and mapping are also handled by the robotic operating system. A Raspberry Pi 3 B+ motherboard with a Broadcom BCM2837 1.2 GHz processor and four Arduino Nano microcontrollers (ATmega 328P 16 GHz) manage the sensors and actuators associated with each subsystem make up the hardware system.

The connection between the processor and the microcontrollers is a full duplex SPI (Serial Peripheral Interface) network, which allows the system to have a total of 7 sensors and 12 actuators, as shown in. The robot units can manoeuvre inside pipes of representative diameters of secondary networks equipped with a metrology system for topographic prospecting tasks. This is done in accordance with the requirements of the lifting procedure based on polygonal circuits by triangulation, under confinement operation conditions in pipelines, including the programming of subsystems in slave controllers. The TORT is a traditional static reference method between points and axes based on laser and topographic triangulation; it does not require GPS support and does not require geodetic correction for short distances. This method can be used in the field with mechanical-optical tools under static collimation conditions (visibility between the references). The TORT procedure is slower than some lidar systems, but it achieves variable regulatory accuracy.

Conflict of Interest

None..

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