Scalar Waves: Modeling Multi-Cellular Behavior in Autonomous Machines via Longitudinal Waves in Multi-Agent Systems

Poondru Prithvinath Reddy

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ABSTRACT

As technology continues to advance, the future of computing and communications is taking new dimensions, one of the most promising emerging technologies in this field is scalar waves. Scalar Waves are often described as having the potential to carry energy and information in a more efficient and profound manner. This deviation from conventional wave behavior is what makes scalar waves a fascinating concept in autonomous systems such as robotics, self-driving cars, drones, etc. Robotics and autonomous vehicles industry could significantly benefit from scalar waves technology as Autonomous vehicles rely on a constant flow of data in real-time for navigation, reliability and safety. This paper delve into the basics of scalar waves and presents an agent-based multi-cell prototype model of the magnetic scalar wave (potential self-regulation) for autonomous vehicles where individual components of robots use multiple programs running on different processors that need to talk to each other in a exchange of information (Processor – Processor). Here the unit level processor components communicate each other both ways i.e. shared memory and message passing via longitudinal waves that propagate in the direction of the magnetic field vector through the channels (featured antennas and inbuilt processor communications module) when two cell processors communicate with each other. The ability to transmit scalar information to target specific parts/components could be a game-changer in autonomous systems reliability and the necessary energy required to power the communication process is provided by the magnetic scalar wave generator itself. This work highlights how the scalar waves might influence agent driven cellular or computer network behaviour and explored the possibility of deploying such systems in actual autonomous machines. However, this paper is not about the technology for generating and detecting scalar waves.

INTRODUCTION

Scalar waves are often described as standing waves, meaning they do not move through space but exist as stationary patterns of energy. Unlike conventional EM waves, scalar waves are believed to be non-Hertzian, meaning they do not travel through space in the same way as traditional electromagnetic waves. Scalar waves are thought to exist beyond the limitations of Hertzian waves, which have a specific frequency and wavelength. Scalar waves are believed to have zero frequency, meaning they do not oscillate in the traditional sense. This property allows them to transcend the constraints of space and time.

Scalar waves are hypothetical waves, which differ from the conventional electromagnetic transverse waves by one oscillation level parallel to the direction of propagation, they thus have characteristics of longitudinal waves. Scalar waves are superluminal, which means they move faster than the speed of light, because they are unbounded by the limitations of 3D space. Also, since they don't exist in the third dimension in the same way that matter does, they move through the empty space between all matter.

A scalar quantity is defined as the physical quantity that has only magnitude. On the other hand, a vector quantity is defined as the physical quantity that has both magnitude as well as direction. Scalar, a physical quantity that is completely described by its magnitude. Temperature is a scalar quantity as it is independent of direction at a point. Wavelength is a scalar quantity. It has magnitude but not direction. Examples of scalars are volume, density, speed, energy, mass, etc.

Conventional network communication is a digital telecommunication network that allows nodes to share data with each other and it is also known as a traditional network, computer network, or data network. Network Communication is **a critical process that allows computers to exchange data and information**. This exchange happens over a shared medium, either wired (like Ethernet) or wireless (like Wi-Fi or 5G). The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams. In computer networks, a "signalling mechanism" refers to a system used to establish and manage communication between network devices, essentially sending control messages to set up connections, manage calls, or coordinate data transfer, often utilizing dedicated protocols to convey this information alongside the actual data stream itself. However, the emerging concept for advanced communication technologies involving Magnetic Scalar Waves enable digital Communication challenging the conventional communication signalling mechanism by proposing cells or computers on a network communicate through scalar magnetic waves, with network devices acting as antennas, thus introducing an entirely new dimension to the field of computer and data networks..

METHODOLOGY

Cellular Automaton Model

A cellular automaton model is defined as a computational model consisting of a grid of cells, each having a specific state that evolves over time based on the states of neighboring cells,.

A cell-based model is **a simulation model that predicts collective behavior of cell-clusters from the behavior and interactions of individual cells.**

Cellular computing typically refers to a decentralized approach to computing where individual devices or nodes, often referred to as "cells," work together to perform tasks. A cell-based architecture uses multiple isolated instances of a workload, where each instance is known as a cell. Each cell is independent, and handles a subset of the overall workload requests.

A major advantage of whole-cell modeling is that these data are linked mechanistically in the model, through the simulated interaction of structured processes in the cell. This mechanistic linkage provides the most natural, intuitive interpretation of an integrated dataset.

Agent-based Models

Within the field of computational modeling they are often simply called agent-based models of which they are a specific application and they are **used for simulating the specific structures such as parts or components**.

Agent-based modeling (ABM) is a methodology used to build formal models of real-world systems that are made up by individual units (such as e.g. atoms, cells, animals, people or institutions) which repeatedly interact among themselves and/or with their environment.

An Agent based model is one that uses internal memory and a percept history to create a model of the environment in which it's operating and make decisions based on that model.

The three major components of an ABM (Agent-based Model) are **agents, the topology, and the environment.**

The agent function **describes how the data collected is translated into actions that support the agent's objective**. When designing the agent function, developers consider the type of information, AI capabilities, knowledge base, feedback mechanism, and other technologies required.

There are different types of agent-based models and one of them is Multi-Agent Systems (MAS).

Topology

The three major components of an ABM (Agent-based Model) are **agents, the topology, and the environment.**

In agent-based systems (ABS), topology refers to the structure that defines how agents interact with each other:

A topology is a system map that shows the position of agents and how they are connected. It has two aspects: the rules and the link structure.

The topology of agent interaction determines how the agents control and communicate with each other, what are the control and communication capabilities of each agent and the whole system, and how efficient the control and communications are.

AI Agents

An artificial intelligence (AI) agent is a software program that can interact with its environment, collect data, and use the data to perform self-determined tasks to meet predetermined goals. Humans set goals, but an AI agent independently chooses the best actions it needs to perform to achieve those goals. For example, consider a contact center AI agent that wants to resolves customer queries. The agent will automatically ask the customer different questions, look up information in internal documents, and respond with a solution.

Architecture is the base the agent operates from. The architecture can be a physical structure, a software program, or a combination. For example, a robotic AI agent consists of actuators, sensors, motors, and robotic arms.

The agent function describes how the data collected is translated into actions that support the agent’s objective. An agent program is the implementation of the agent function. It involves developing, training, and deploying the AI agent on the designated architecture. The agent program aligns the agent’s business logic, technical requirements, and performance elements.

AI agents need information to act on tasks they have planned successfully. For example, the agent must extract conversation logs to analyze customer sentiments. In some applications, an intelligent agent can interact with other agents or machine learning models to access or exchange information.

With sufficient data, the AI agent methodically implements the task at hand. Once it accomplishes a task, the agent removes it from the list and proceeds to the next one. In between task completions, the agent evaluates if it has achieved the designated goal by seeking external feedback and inspecting its own logs.

A multi-agent system is a collection of artificial intelligence (AI) agents that work together to solve problems or complete tasks. MASs are a key area of AI research, and are used in many applications, including autonomous driving, automated trading, and commercial games.

ARCHITECTURE

A functional architecture is an architectural model that identifies a system’s functions and its interactions and how they work together to achieve some mission goal.

A **self-driving car**, also known as a **robot car**, or **autonomous car**, is a vehicle that is capable of sensing its environment and moving with little or no human input. Autonomous cars combine a variety of sensors to perceive their surroundings, such as radar, Lidar, sonar, GPS, odometry and inertial measurement units. Advanced control systems interpret sensory information to identify appropriate navigation paths, as well as obstacles and relevant signage.

For a machine to be called a robot, it should satisfy at least three important capabilities: to be able to sense, plan, and act. For a car to be called an autonomous car, it should satisfy the same requirements. Self-driving cars are essentially robot cars that can make decisions about how to get from point A to point B.

A car capable of autonomous driving should be able to drive itself without any human input. To achieve this, the autonomous car needs to sense its environment, navigate and react without human interaction. A wide range of sensors, and cameras are used by self-driving cars to perceive their surroundings. In addition, the autonomous car must have a control system that is able to understand the data received from the sensors and make a difference between traffic signs, obstacles, pedestrian and other expected and unexpected things on the road.

For a vehicle to operate autonomously several real-time systems must work tightly together. These real-time systems, include environment mapping and understanding, localisation, route planning and movement control. For these real-time systems to have a platform to work on, the self-driving car itself needs to be equipped with the appropriate sensors, and an on-board computer enabled with computational HW, networking and SW infrastructure.

On-board computer. This is the core part of any self-driving car. All sensors connect to this computer, which has to make use of sensor's data by understanding it, planning the route and controlling the car's actuators. The control is performed by sending the control commands such as steering angle, throttle and braking to the wheels, motors and servo of the autonomous car.

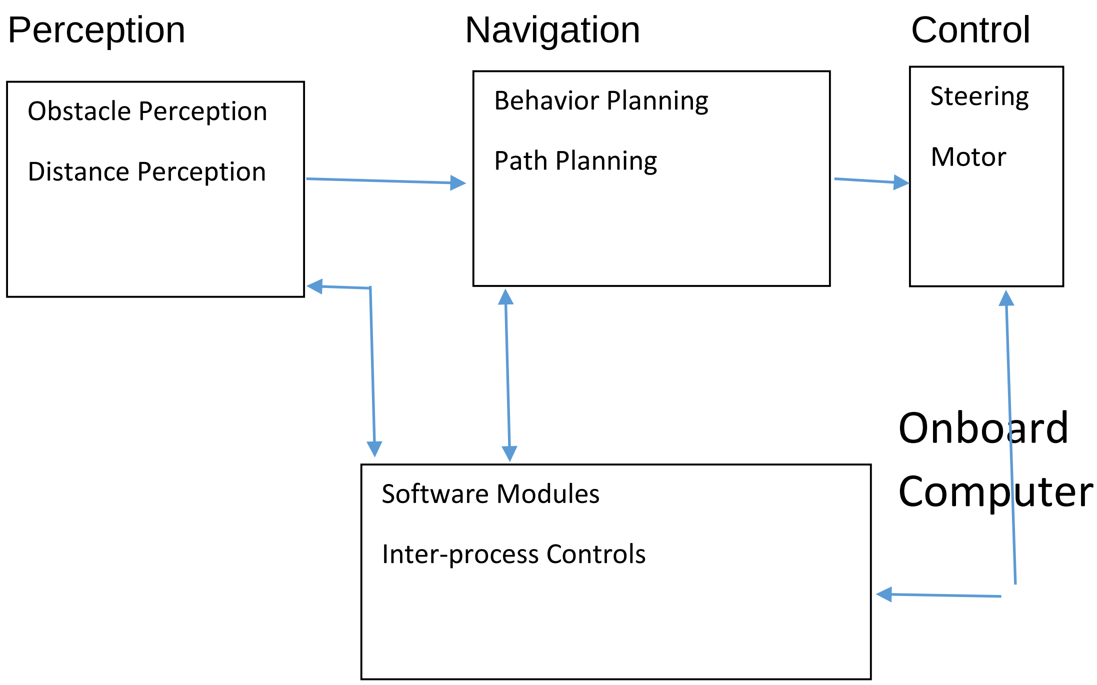

Fig. 1 - Key Components of a Robot Car

Each Cell-block seen in Figure 1 can interact with other cells using inter-process communication (IPC) or shared memory,

The key technology of self-driving car is divided into three parts according to the function of a autonomous car: environment perception, car navigation, and the car control.

Perception modules. These modules process perception data from sensors such as LIDAR, RADAR and cameras, then segment the processed data to locate different objects that are staying still or moving These modules also help in self-driving car localisation, relative to the generated map of the environment.

Navigation modules. Navigation modules determine the behaviour of the self-driving car, as they have route and motion planners, as well as a state machine of car's behaviour. To generate the most optimal route for the car to get from point A to point B, navigation modules communicate with perception modules.

Vehicle interface. This interface's goal is to send control commands such as steering, throttle and braking to the car after the path has been plotted in the navigation module.

we can broadly categorize the main components of the autonomous vehicle, like any other machine, into hardware and software. Hardware splits broadly into sensors, Vehicle-to-Vehicle (V2V) and Cameras, and actuators. Software splits broadly into processes for perception, planning, and control.

Autonomous Vehicle Hardware

The hardware components of the autonomous car which allow us to interact with the stimuli of the outside world. The hardware components enable the car to complete such tasks as seeing (through sensors), communicating (through V2V technology), and moving (through actuators).

Autonomous Vehicle Software

Whereas the hardware components of the autonomous car enable the car to perform such functions as see, communicate, and move, the software which processes information about the environment so that the car understands what action to take—whether to move, stop, slow down, etc. Autonomous vehicle software can be categorized into three systems: perception, planning, and control.

On-board System

Synergistic Combining of Sensors - All the data gathered by these sensors is collated and interpreted together by the car’s CPU or in built software system to create a safe driving experience.

The software has been programmed to rightly interpret common road behaviour and motorist signs. For example, if a cyclist gestures that he intends to make a manoeuvre, the driverless car interprets it correctly and slows down to allow the motorist to turn. Predetermined shape and motion descriptors are programmed into the system to help the car make intelligent decisions.

Processor-to-Processor

Autonomous car or robot car is modeled on a cell-based architecture uses multiple instances of a workload, where each instance is known as cell. Each cell is independent, does share information with other cells, and handles a subset of the overall workload. This approach typically refers to a decentralized approach to computing where individual components work together to perform tasks, and is a simulation model that predicts collective behavior of cell-clusters from the behavior and interactions of individual cells.

Within the field of computational modeling, there are agent-based models of which they are a specific application and they are used for simulating the specific structures such as parts or units, and in the case of autonomous vehicles, we modelled them for object detection, path planning, etc.

A major advantage of agent driven cell modeling is that these data are linked mechanically in the model, through the simulated interaction of structured processes in the cell. This mechanistic linkage **provides the most natural, intuitive interpretation of an integrated dataset.**

Each cell seen in the Fig. 1 can interact with other cells using process-to-process communication both by sharing memory and messaging system and different functional cells of typical robot car are as shown in the Fig. 1. All the data gathered by these agent driven cells is collated and interpreted together by the cars on-

board CPU or in built software system to create a safe driving experience.

The agent driven cell software splits broadly into processes for perception (object detection agent, distance measurement agent), navigation (behavior agent, path agent) and control(steering agent, motor agent).

Processor-to-Processor Communications

Processor-to-processor is the exchange of information between agent programs, which is across cell units where multiple programs talk to each other for working together. In a multiprocessor system where individual unit is equipped with a computer system and similar such systems are connected together to solve a common problem of autonomous driving. Each processor has its own memory and it is accessible by that particular processor and those processors that are linked with each other. In this process, operations at cell level enables different programs to run in parallel, share data and communicate with each other. The action synchronization between processes can be seen as a method of co-operation between them and processes can communicate with each other through both shared memory and message passing.

In this, the magnetic waves enable cell communication where cell units communicate through scalar magnetic waves with unit level processors featuring its own antennas (**converts electric current into electromagnetic (EM) waves or vice versa)**.

The unit level processors along with transducer can resonate at specific frequencies when exposed to magnetic fields thereby functioning as antenna. This structural property of processor might allow it to emit and receive electromagnetic signals facilitating a mode of communication between cells that bypasses conventional communication pathways as scalar waves – a type of wave that could enable a faster and more efficient form of signaling.

In a robot car, external electromagnetic or environmental fields can influence cellular behavior and agent processes, the cell units may possess inherent electromagnetic properties, thus making them responding to these scalar waves. Furthermore, cell generated longitudinal waves, which propagate in the direction of the magnetic field vector, suggest cell processor structure optimizes efficiency.

The cell processor enabled with antenna like capability might synchronize crucial cellular activities through electromagnetic signaling. The potential for magnetic scalar waves to modulate structured information/codes stored in processor base pairs offers an exciting framework for understanding their role in cellular communication.

The implications of scalar wave theory for robotics extend far beyond basic cellular communication. If validated, this paradigm could revolutionize many fields as the concept of scalar wave communications may provide innovative approaches as it is based on electromagnetic frequencies and high information density through the miniaturization of potential processors in the cell units presents exiting possibilities.

Communications Processor Module

The unit level cell processors in a robot designed to provide features related to imaging, navigation and communications. A processor can delegate most of the input/output processing (for example sending and receiving data via the interface) to the Communications Module within the Processor and the processor does not have to perform those functions itself as most of the input/output functions require quick response from the processor, for example due to precise timing requirements during data transmission. With Communication Module(CM) performing those operations, the main processor is free to perform other tasks as the CM features its own Communication Processor, separate from the core central processing unit.

RESULTS

Due to non-availability of infrastructure for scalar wave generation and tracing for multi cell integrated data, the experimental results could not be made available however, it is believed that the proposed model of multi-cell multiple agent driven programs on processors featuring antennas and separate communication module will hold good for scalar waves as they are based on the principles behind longitudinal wave propagation for applications in autonomous systems.

Therefore, the concept of scalar waves and their communication implications require more experimental processes to verify the usefulness. The implications of scalar wave theory for robotics and autonomous systems extend far beyond basic cellular communication. If validated, this paradigm could revolutionize many fields besides robotics as the concept of scalar wave communications as it is based on electromagnetic frequencies and high information density through the miniaturization of potential processors in the cellular units presents exiting possibilities.

CONCLUSION

The future of computing and communications is taking new dimensions, one of the most promising emerging technologies in this field is scalar waves. Scalar Waves are having the potential to carry energy and information in a more efficient manner and this deviation from conventional waves is what makes scalar waves a fascinating concept in autonomous systems. Scalar waves ability to transmit information instantaneously could enhance the real-time decision-making capabilities of autonomous vehicles and robotics. This paper presented an agent-based multi-cell prototype model of the magnetic scalar wave (potential self-regulation) for autonomous vehicles where individual components of robots use multiple programs running on different processors that need to talk to each other in a exchange of information (Processor – Processor). Here the unit level processor components featuring antennas and communication modules exchange information each other both ways i.e. shared memory and message passing. The characteristics of the potential agent driven allows enormously high information density in the generator and the ability to transmit scalar information to target specific parts/components could be a game-changer in autonomous systems reliability. This work highlights how the scalar waves might influence agent driven cellular or computer network behaviour and communication processes and explored the possibility of deploying such model in realistic autonomous machines.

REFERENCE

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