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Stabilizing a network in linear network system

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Abstract: Linear network systems in which nodes transmit data from source nodes to sink nodes. Many systems are working by use of networks and controllers are used to control network system. Stabilized linear network system should be established for the access of the data among nodes in the network and control the system. This is to improve the network efficiency, scalability and get the optimization path to the network. This process used to attain the maximum possible information flow in the network. By analysing all the paths of the network, the optimized network is found in the network among the nodes. It is to design control mechanism that can maintain stability under varying input and disturbance conditions. The effectiveness of the control strategies depends on the network dynamics, input output characteristics and available sensors and controllers. The success of the stabilization process is evaluated based on the network ability to maintain stability under different operating conditions.

Index terms: Sensor nodes, Controller, Base station, Wireless sensor network, Optimized path.

1.INTRODUCTION

Network systems arise in many applications. In the system, nodes must use sensed data to characterize the network must coordinate with one another to predict the network response and decide their control actions. It computes the control in a distributed manner and pose the control synthesis as a network optimization in the system. The network system is established in graphical manner with the nodes and optimized path selection by the distributed data is predicted with least distance among the nodes. Stabilizing the network in the system by considering the distributed data of the nodes. The node will sense the data and check the neighbouring node data to get the distributed data. Sensor nodes are generally equipped with a radio transceiver, a microcontroller, a memory unit, and a set of transducers with which they can acquire and process data. To reduce each node's size and energy requirements this method is efficient. The path to the controller node and the base station without interruption of the other networks. The path should be identified among the nodes and resultant optimal path is recorded. Data based predictive control method of the node should be used to analyse an efficient path to control system. Networks can broadly classify its benefits as resulting in improvement in a network's throughput, efficiency, and scalability. Nodes monitor and record the physical conditions of the environment and forward the collected data to a central location. In a networked system, distributed data-based predictive control can be used to stabilize the system by utilizing data from multiple sources to predict system behaviour and make control decisions in a decentralized manner. The approach uses machine learning algorithms to model the relationships between inputs and outputs in the system and make predictions about future system behaviour. These predictions are then used to determine the control inputs needed to stabilize the system.

1.1 Objectives:

The main objective of the project is to stabilize the network among the nodes and efficient network link among the nodes with the use of controllers and the neighbouring nodes of the source node. The required data is obtained from the neighbouring nodes and the node itself and then check the least distance, less energy resources usage in the network. The Data based predictive control algorithm is used to predict the network link to the nodes and optimization technique is used to get the optimized path among the nodes.

2. LITERATURE SURVEY

2.1 Literature review on optimal distributed controllers for linear systems obtained as solution to convex program.

A literature review on optimal distributed controllers for linear systems obtained as a solution to a convex program would focus on research that develops and analyses methods for designing distributed controllers for linear systems using convex optimization. In recent years, there has been growing interest in using convex optimization methods to design distributed controllers for linear systems. One popular approach is to formulate the control design problem as a convex optimization problem and then use algorithms such as consensus or distributed gradient descent to solve the problem in a decentralized manner. These methods have been shown to be effective in designing distributed controllers for a variety of linear systems, including systems with decentralized control, systems with communication constraints, and large-scale systems. The key advantage of these methods is that they guarantee the optimality of the solution and provide a way to handle the uncertainty in the system dynamics and the communication constraints in the network.

2.2 Literature review on reinforcement learning for controlling robots and multi agent systems.

RL is a powerful tool for designing control policies for complex and dynamic systems, such as robots and multi-agent systems. It involves learning a mapping from states to actions through trial-and-error, where the agent learns to perform actions that maximize a reward signal. In the context of controlling robots, RL algorithms have been used to learn control policies for tasks such as walking, grasping, and manipulation. For example, in the field of legged robots, RL algorithms have been used to learn walking policies that are robust to changes in terrain and environmental conditions. In the field of grasping and manipulation, RL algorithms

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have been used to learn control policies that enable robots to perform complex tasks such as pick and-place and grasping of unknown objects. In the context of multi-agent systems, RL algorithms have been used to learn control policies for tasks such as coordination, cooperation, and competition among multiple agents. However, the literature review would also highlight some of the challenges and limitations of RL, such as the need for large amounts of data, the difficulty in dealing with high-dimensional state spaces, and the need for efficient algorithms that can scale to large systems.

2.3 MPC formulations are available for multi agent systems and each agent implements a control policy minimizing its objective for network interactions locally using network optimization algorithm.

Model Predictive Control (MPC) formulations for multi-agent systems would focus on the methods for designing distributed MPC algorithms for networks of agents, where each agent implements a control policy that minimizes its own objective while considering the network interactions locally. One approach to designing distributed MPC algorithms is to use network optimization algorithms. In this approach, the overall MPC problem is formulated as a large-scale optimization problem that considers the objectives and constraints of each agent and the interactions between the agents in the network. Each agent then solves a local subproblem, which is a reduced-order version of the overall MPC problem, and the solutions are used to compute the control actions.

2.4 Literature review on behavioural systems which characterizes system trajectories from single sample trajectory has gained attention in area of data-based control.

Behavioural systems that characterize system trajectories from a single sample trajectory would focus on the recent advances in the area of data-based control, where the control strategy is designed based on data collected from the system, without the need for a system model. Behavioural systems aim to learn the underlying dynamics of the system based on a single sample trajectory, and then use this information to control the system in real-time. This approach is particularly useful in situations where it is difficult or impossible to obtain a mathematical model of the system, such as in complex and nonlinear systems. One of the main methods used in the literature for characterizing system trajectories is System Identification, which involves estimating the parameters of a mathematical model that describes the system behaviour. There has been significant research in recent years on data driven SI methods, including methods based on machine learning and deep learning algorithms, that can accurately estimate the system dynamics from a single sample trajectory.

3. EXISTING SYSTEM

An optimal designed distributed controllers for linear systems are obtained for solution to convex program and formulate a control design problem as a convex optimization problem. Reinforcement learning is a powerful tool for designing control policies for complex and dynamic systems such as robots and multi agent systems. It involves learning a mapping from states to actions and learns to perform actions that maximize the reward signal. In the context of multi-agent systems. Model Predictive Control formulations for multi-agent systems would focus on the methods for designing distributed MPC algorithms for networks of agents, where each agent implements a control policy that minimizes its own objective while taking into account the network interactions locally. Behavioural systems that characterize system trajectories from a single sample trajectory would focus on the recent advances in the area of data-based control, where the control strategy is designed based on data collected from the system, without the need for a system model. Convex optimization problems can be computationally expensive to solve, especially for large-scale systems. If the model used in the optimization problem does not accurately reflect the true system dynamics, the resulting controller may not perform well. MPC algorithms can be computationally expensive, especially in large-scale systems, which can limit their applicability to real-world problems. MPC algorithms can struggle with large-scale systems, where the number of states and inputs can become very large. MPC algorithms can require efficient optimization algorithms to solve the large-scale optimization problems.

4. PROPOSED SYSTEM

The network is stabilized by the distributed data sensed by nodes and then nodes coordinate with the controller nodes for the stability. one example of a network system where nodes are connected to a controller, which is then connected to a base station, is a wireless sensor network. In a WSN, nodes are small wireless devices that are equipped with sensors and are distributed throughout an area to collect data. The nodes communicate with each other wirelessly to form a network. The base station in a WSN is typically a more powerful device that is used to collect and process the data from the nodes, and to communicate with other systems. In a star network system, nodes are typically connected to a central hub or a base station through wired or wireless links. The central hub or base station acts as a central point. of communication and controls the data flow between the nodes and the other devices in the network. In this type of network, it is possible to have a controller connected to the central hub or base station, which can then control the output of the physical system based on the data received from the nodes. The nodes could be sensors that collect data on various parameters such as temperature, pressure, and flow rates, and the controller could be a valve that controls the flow of a fluid in the process based on the data received from the nodes. In a network, it is possible to have nodes connected to a controller, which in turn is connected to a base station. In this type of network, the communication between the sensing nodes, controller nodes, and base station would be mediated by the network topology, with short-range connections used for local communication and longer-

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range connections used for global communication. The network topology is relatively simple to set up and maintain. Each node is connected to a central hub, making it easy to communicate in the network. The base station in a network act as a central access for the entire network. This makes it easier to monitor and manage the network, including adjusting the nodes to maintain stability. Each node communicates with the controller and then the base station, which reduces the need for unnecessary transmissions between nodes. This makes the network more efficient and helps to conserve energy.

5. METHODOLOGY

Data based predictive control algorithm uses data-driven approach to predict system behaviour and optimize control actions. It can optimize control actions based on performance criteria such as energy efficiency. It is a promising approach for stabilizing networked systems and has the potential to improve system performance and efficiency. In a wireless sensor network, sensors may be connected to controllers that control physical processes, and the sensors and controllers may communicate with a base station to exchange data and control signals. The base station may be used to aggregate data from the sensors, control the controller, and provide an interface for human operators to interact with the system. Data-based predictive control algorithm can be used in wireless networks with controllers and base stations to achieve stability and improve performance. The control action is then applied to the controller of the network nodes to stabilize the system. The base station plays a critical role in this approach by providing a centralized location for collecting data from the network nodes and implementing the predictive controller. The network topology is relatively simple to set up and maintain. Each node is connected to a central hub, making it easy to communicate in the network. The base station in a network act as a central controller for the entire network. This makes it easier to monitor and manage the network, including adjusting the nodes to maintain stability. Each node communicates with the controller and then the base station, which reduces the need for unnecessary transmissions between nodes. This makes the network more efficient and helps to conserve energy.

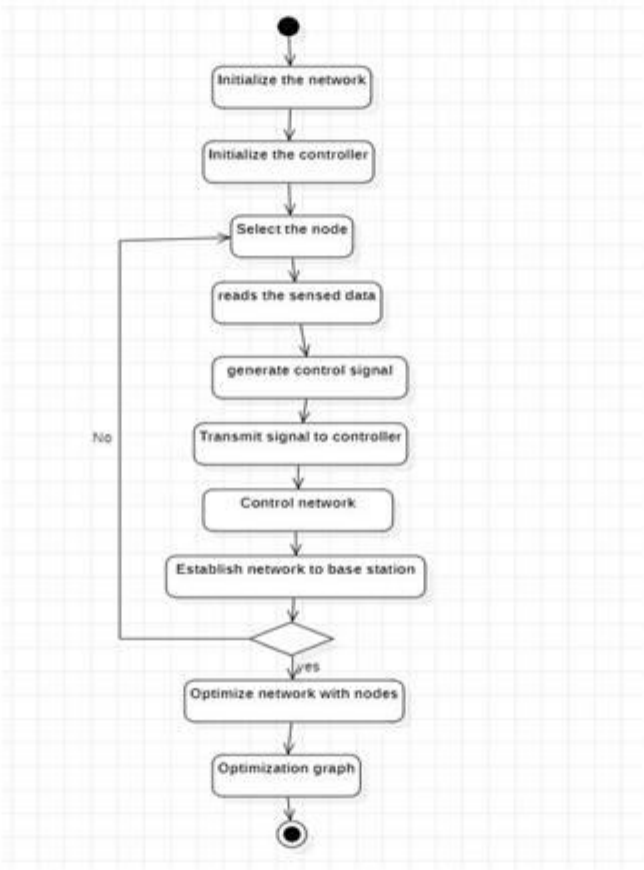

Fig1: Process of formation of network

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6. TESTING

Testing in the network system is done based on the data flow and the traffic congestion and the data packets transfer. Cisco packet Tracer is a powerful tool that can be used to design, configure and troubleshoot network topologies. It allows to create virtual networks with different devices such as PC, routers, switches and simulate network traffic and behaviour. The network is first need to be establishes. Start by designing the network topology using the devices available in cisco packet tracer. The devices need to be dragged and dropped from the device palette onto the workspace and connect them using cables. Once the network topology is designed, devices are configured by double clicking on them and entering the appropriate settings. Now we can configure IP addresses on the devices, set up routing protocols, and configure access control lists After configuring the devices, test the network topology by using the simulation mode. Simulate the traffic by generating pings, HTTP requests, and other network traffic. We can also view the routing tables and monitor the network traffic using the various tools available in Packet Tracer. If we encounter any issues or errors, we can troubleshoot them by analysing the network topology and the devices configurations. We can use the CLI (Command Line Interface) to diagnose and fix problems, or can use the simulation mode to observe the network behaviour.

Data simulation testing is a technique used to simulate real-world data scenarios and test the behaviour and performance of software applications under various conditions. The purpose of data simulation testing is to ensure that the application can handle different types of data and that it operates correctly in various data-related scenarios. Wireless sensor networks (WSNs) are networks of interconnected sensors that communicate to transmit data to a controller or base station. Use the Cisco Packet Tracer to design the topology of the WSN. The topology should include sensors nodes, a controller, and a base station or the server. The sensors should be deployed randomly in the simulation area. The controller and the base station should be placed strategically in the simulation area for better coverage. Start the simulation and test the WSN by sending data from the sensors to the controller and base station. we can use the command-line interface of the sensors to generate test data and send it to the controller and base station. Monitor the traffic between the sensors, the controller, and the base station Analyse the test results to identify any issues with the WSN. Based on the analysis of the results, optimize the network parameters, such as the channel and transmission power, to improve the performance of the network.

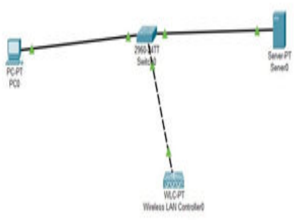

Fig2: Cisco packet tracer

Fig3: Data transfer

7. CONCLUSION

The project intents to stabilize the network based on the data. Data-based predictive control algorithm has emerged as a promising approach for stabilizing wireless networks with controllers and base station. DBPC offers several advantages over traditional control approaches. Furthermore, DBPC can be implemented in software or hardware, making it a flexible and cost-effective solution for stabilizing wireless networks. With further research and development, DBPC has the potential to become the preferred control algorithm for stabilizing a variety of networked systems. The predicted behaviour is then used to optimize the control inputs to the controller in order to maintain stability and achieve desired performance criteria. This is able to incorporate constraints on the control inputs and outputs, which is important in networks where there may be limitations on power or bandwidth. DBPC has the ability to improve the stability and performance of wireless network systems with controllers and a base station.

8. FUTURE ENHANCEMENTS

In this project, there are several potential enhancements that can be made to improve the performance of data-based predictive control algorithms for stabilizing wireless networks. Researchers can explore new modelling techniques, such as deep learning or hybrid modelling approaches, to improve the accuracy of the models. Wireless networks are inherently dynamic and can experience significant changes in topology and traffic patterns over time. Future work can focus on developing control algorithms that are more robust to these changes and can adapt quickly to new network conditions. Finally, to demonstrate the effectiveness of data-based predictive control algorithms, it is important to conduct experimental studies in real-world wireless network environments. It can focus on designing and conducting experiments to validate the performance of the algorithms under realistic conditions and on developing algorithms that can be implemented in real-time, either in software or hardware, and can operate efficiently with limited computing resources.

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