Optimal coverage control - Discussion on 21/3

Main topic: Identify the main contributions

- ***Design of Barrier Lyapunov Function for Coverage Control Task***

Apply the theorem of BLF, to design the Lyapunov function for the coverage control problem. The design is challenging due to the following reason. The control targets (Central mass of Voronoi partitions) depend on agents and their neighbors. Suppose there exists a local Lyapunov function V_k applied for a single agent and we want to derive the control input from this function. Because the V_k contains the term C_k, which depends on z_k and its neighbors, the time derivative of V_k will require the control input of the neighbor agents (in $\partial z_{neighbot}/\partial t$) as well. This impairs the distributed characteristic of coverage control. This motivates us to find a global Lyapunov function (contains the global state of all agents), whose time derivative can be controlled distributedly. This allows the control input to ensure the stability of the coverage control, while the boundedness of the global BLF guarantees the state constraint. This is the biggest contribution of this study.

- ***Different approach in comparison to the previous studies***

There are 2 differences in comparisons to the previous studies
1) Single Integrator System vs Nonholonomic robots
Unlike a system that has a single integrator dynamic, the center masses are not driven straight forward to the target, instead they might be driven in a curve (piecewise). Therefore it is difficult to consider the state constraint. This lead to the second point, where we compare two known approaches

2) Nagumo vs BLF approach
By applying the theorem of BLF, we achieve a smooth system. Our control input drives the robot's center mass directly to converge on the CVT. We do not use switching control law (I am not quite sure if this is also a contribution, but I think it is more beautiful)

Conclusion
Main contribution:
Solve the problem of coverage control under consideration of multiple constraints
The design of BLF with the following characteristics:
- Its time derivative can be computed distributedly
- It guarantees the state constraints of all agents
- Performance in comparisons to the previous studies ?

Planning
- Prepare Git Repo for src code
- GG Drives for simulation videos and documents
- Wechat group for discussions
- Zoom for meetings

Todo
Change figure 3 with different colors

Deadline: End of May