Summary

During the meeting on October 23rd, I started by discussing equation 6 and emphasized the importance of the order in min-max optimization. I explained that we cannot switch the min and max operators, though I initially misunderstood this point. I then introduced the concept of the curvy beta from reference 36, which assumes that if a mapping function implies y and y hat​ are equal, the mapping function at τ between them remains the same. This allows us to prove the upper and lower value strategy sets, eventually leading to a viscous solution.

I should mention that I didn’t fully grasp the paper on "Differential Games and Representation Formulas for Solutions of the Hamilton-Jacobi-Isaacs Equation." Afterward, Dr. Petrik noted that the robust controlled invariant set is not unique. I explained that while the invariant set itself is unique, the way Dr. Petrik described it—considering that the dynamics are zero and that there could be different sets that are unique—was accurate. However, the safe set, defined as Ω, might be unique because it represents the maximum invariant set. It appears that other invariant sets are subsets of this maximum one.

Dr. Petrik also asked why the term "discriminating kernel," which is supposedly identical to the safe set, was used. I had no immediate answer to that. Finally, we arrived at equation 7, which forms the heart of the control portion of the paper. Before tackling this equation, it seems they worked hard to connect the cost function to the value function, leading to the viability theorem. They then introduced assumptions from reference 36 to reformulate the problem as an HJI, solving it using variational inequality.

Another question arose: why ensure that the value function is never less than the l-function, which is the signed distance function over the feasible set K. Dr. Yoon explained, based on a video he watched, that the other invariant sets are compared with the maximum invariant set, with the worst-case scenario being represented by l. I honestly still did not fully understand why we have this inequality constraint until Dr. Petrik began writing the Bellman equation, linking it to dynamic programming.

When he explained that the cost function is not additive because there is no integration term, and that the signed distance function represents the worst-case scenario, it made sense due to the nature of dynamic programming. In this framework, whatever happens in the current stage is considered the worst-case scenario, and we proceed to see if a worse scenario can be found, which was quite logical. Dr. Petrik also referenced a robust optimization book, specifically Chapter 14, which discusses robust optimization with adjustable control parameters. He suggested that improvements could be made to the current work, noting that it seems too risk-averse. I agreed, adding that the paper appears to contain unnecessary complexity, particularly in the Bayesian modeling part, and that these aspects could be improved.

I just rewatched the video by Tomlin, and around the 31-minute mark, she discussed how the order of max-min and min-max plays a critical role in the avoid set problem. In the paper, it seems that the first action is determined by the input, and then we examine how the disturbance behaves. This indicates that the scenario presented is not the worst-case scenario, or at least it conflicts with the true worst-case scenario. She also mentioned the role of curvy B, explaining how it functions as a mapping between the constraints in the UUU set and DDD, showing its significance in this context.