Summary

In this meeting, I began by arguing that the min-max order is important, and I was curious about how the lower bound value of the viscous solution relates to Equation 6 in the general framework paper. However, Dr. Yoon and Dr. Petrik claimed that this is not a significant issue and that the order is not so important in this context.

I then went through Proposition 4, which states that any superlevel set of the value function is an invariant set. I mentioned that because the lower bound of Equation 7 is zero, the gradient of the value function and dynamics must be greater than or equal to zero. However, Dr. Petrik pointed out that we should consider Equation 5, where the function is defined as the infimum of the 𝑙 function, and it seems that this function does not change. He argued that although this function appears to be dependent on the state, it essentially indicates whether you are safe or not—a binary function distinguishing between unsafe and safe states. I believe this is due to the nature of the signed distance function.

They also discussed whether there is any way to fix the issue once the safety constraints are violated. Marek suggested that instead of using the infimum, we could use the supremum, but this is still confusing to me because the signed distance function has two conditions. During this discussion, I mentioned that if a point is not in the invariant or safe set but is within the feasible set, the optimal control can push the trajectory back to the invariant set. However, Ola, Dr. Yoon, and Dr. Petrik argued that no, it means you do not have any chance to get back to the invariant set. It seems that whenever the learning-based controller touches the boundary, the optimal controller pushes it back to the safe set. I argued that the filter indicates we can push it back if we leave the invariant set because, as I showed with the MPC controller, it is possible—but perhaps the set we considered was not the maximum invariant set.

After this discussion, I proceeded to the Bayesian safety analysis. I noted that initially, there is a prior normal distribution, and then the posterior adjusts the variance and mean as more data is gathered. I presented Equation 10, but I found it not well-defined. Dr. Petrik explained that this is a multivariate Gaussian posterior update and mentioned that there is a significant contribution here that we can explore. I asked for references, and he provided me with a June 2024 paper about bandits and risk, which I am eager to read.

I also inquired about the next steps for our upcoming meeting. They advised me to find new references for this paper through Google Scholar and to continue developing a deeper understanding of the Bayesian model. This is important because, when I was explaining Equation 16, some notations were hard to understand, and it still isn't clear to me what they are doing with different superlevel sets of the value function and why they are considering the probability of these sets within different level sets of the value function.