Abstract　論 文 の 内 容 の 要 旨

論文題目　Multi-Stage Robust Decision Making: Decision Support Framework Under Deep Uncertainty and Its Application to Technology Roadmapping
（多段階ロバスト意思決定:深い不確実性の下での意思決定支援フレームワークと技術ロードマッピングへの応用）

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In large and complex projects, it is crucial to acknowledge uncertainties and make decisions that perform well in a wide range of future scenarios. This is because the point estimate of the future is often inaccurate, and even if we know the future uncertainty accurately, making plans only based on the most likely future may results in a bad outcome due to the flaw of averages. It is also worth considering that those uncertainties are often deep, i.e., non-probabilistic, making it challenging to apply conventional probabilistic analyses.

Multi-stage, or sequential, decision making is often effective under a deeply uncertain environment. This dissertation proposes a multi-stage-robust-decision-making Markov decision process (MSRDM-MDP), an extension of a Markov decision process, that can model sequential decision making under deep uncertainty. We show that the maximax and maximin optimal policies can be obtained by solving the maximax and maximin optimal Bellman equations using a reinforcement learning algorithm.

This dissertation also proposes a horizon-of-uncertainty (HoU) analysis that helps decision-makers understand the trade-off between each policy option’s performance and robustness.

Based on these proposed concepts, this dissertation proposes a computer-aided decision-support framework called multi-stage robust decision making (MSRDM) that helps decision-makers make better decisions even under non-probabilistic uncertainties by enabling them to frame the problem as a multi-stage decision-making problem and analyze the trade-off

between the performance and the robustness of each policy option.

Finally, the proposed framework is demonstrated in two case studies: technology roadmapping of the space formation flying system and technology roadmapping of the marine propulsion system.