博士論文を要約したもの

博士論文題目

Utilizing Partial Automation in Imitation Learning for Complex Task Automation

氏　　名

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（要約）

Imitation learning (IL) is a framework for acquiring policies from human demonstration data to replace human-performed tasks with robots and is expected to apply to complex tasks, such as earthwork tasks, assuming long-term operation or partial observability in recent years. The difficulty is that the long-term operation makes a huge demonstration burden, and decision-making based on partial observations makes a high cognitive load, resulting in operation mistakes. Since the resulting diverse-quality demonstration data deteriorates the learned policy's performance, previous studies have discussed the methods that extract optimal policies from diverse-quality demonstration data in a post-processing manner. However, these methods have the issue of data efficiency since they ignore the sub-optimal data. In contrast, our approach aims to prevent demonstration mistakes by focusing on the demonstration data generating process. We get insight from skilled operators of industrial systems who utilize semi-automatic operations along with manual operations to perform complex tasks. Operators perform manual operations where high cognitive ability is required, while automatic operations are used in other situations to reduce the operation burden. This is because manual operation and switching between manual/automatic modes require less cognitive load than continuous manual operations. Inspired by this strategy, we propose a novel IL approach that utilizes partial automation, incorporating the switching structure between pre-designed automatic operations and manual operations into the demonstrator's data generation process. Supplementarily, we also propose an IL approach that learns policies by considering the demonstration quality, and we discuss the intersection between this approach and IL utilizing partial

automation. Experiments are conducted on complex tasks such as earthwork tasks in simulation and on real robot environments to reveal the effectiveness of the proposed approach.