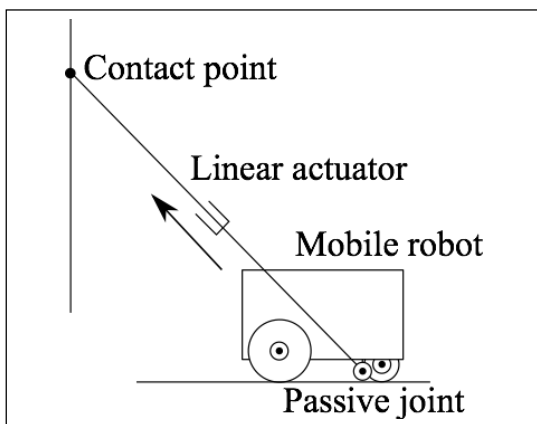


## Development of a robotic arm of mobile robot for large size object manipulation

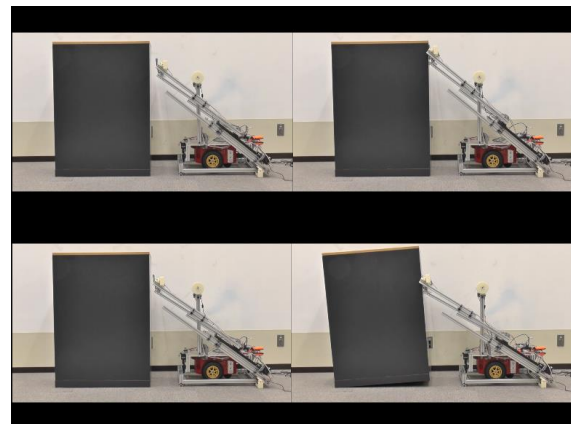
Generally, it is difficult that a small mobile robot cannot exert a large force to the environment, although a small mobile robot can move in the narrow spaces. That is because a small robot has a risk of the robot tipping over or slipping by a large reaction force. If a small mobile robot can exert a relative large force to the environment, the robot can manipulate various objects including a large and heavy object even if a target object offers no gripping point. For example, the robot can tilt a large and heavy object to put a moving cart under it or turn a large and heavy obstacle over to remove it.

In our research, we analyzed limitations of forces which can be applied to the environment by a mobile robot caused by the mechanism of the robot and frictional forces between the robot and the environment to develop a mobile robot allowed to apply a large force. As a result, we proposed a mobile robot a linear actuator connected to the body of the robot via a passive joint as shown in Fig. 1. The robot has no risk of falling because the moment which rotates the robot is not conveyed to the body of the robot due to the passive joint. This makes it possible for the robot to manipulate an unknown object by trial and error without caring about falling of the robot. We demonstrated that the robot can find a direction of force which can be applied to an object without a slippage as shown in Fig. 2. Consequently, the robot could tilt a large and heavy object which weights 80.0 kg without slippage and falling of the robot.

**Keywords:** mobile robot, large force, pushing manipulation



**Fig. 1** Proposed mobile robot with a passive joint



**Fig. 2** Experiment to tilt a heavy object by trial and error