

# ESTIMATING OBJECT KINEMATIC STATE MACHINE VIA HUMAN DEMONSTRATION



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## Objective and Research Question:

The goal of this project is to introduce Object Kinematic State Machines, a representation for modelling articulated objects, and a deep neural network to estimate it.

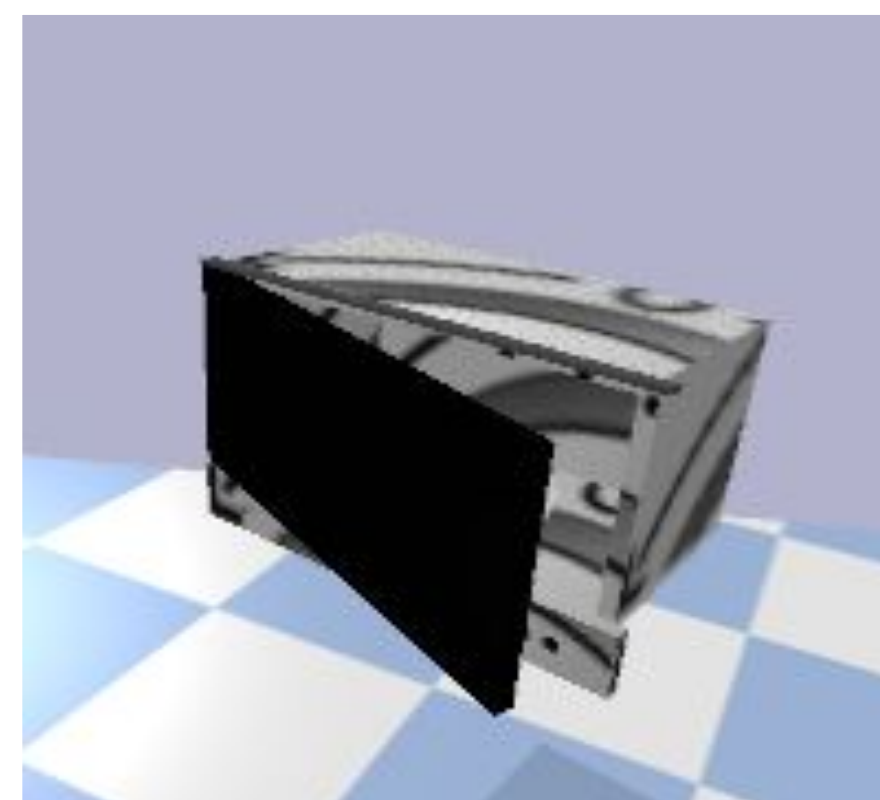
## Motivation

Learning object articulation model of multi-jointed objects using state machines is desirable as it allows the manipulation of objects robust to robot type and extrinsic parameters in a sequential manner.

## Related Work:

- Screwnet
- Learning to Generalize Kinematic Models to Novel Objects

## Dataset:



## Challenges:

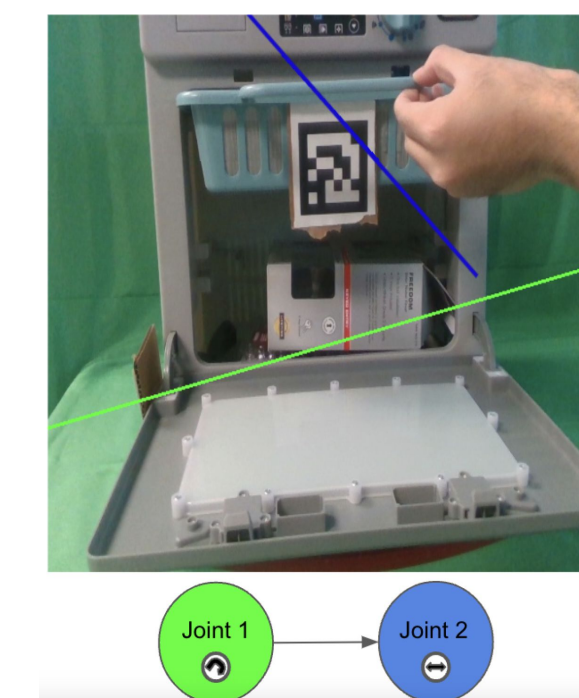
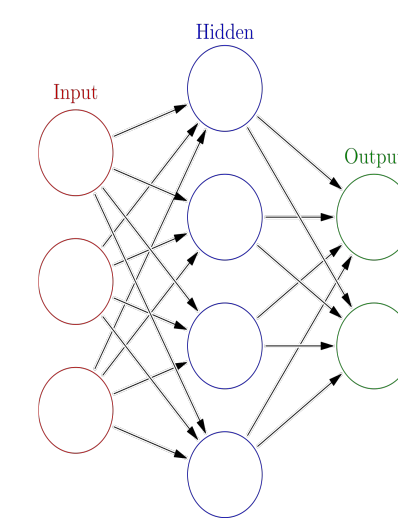
- Where are the joint axes?
- What type of joint it is?
- In what order the joints are manipulated?

## Dataset Collection:

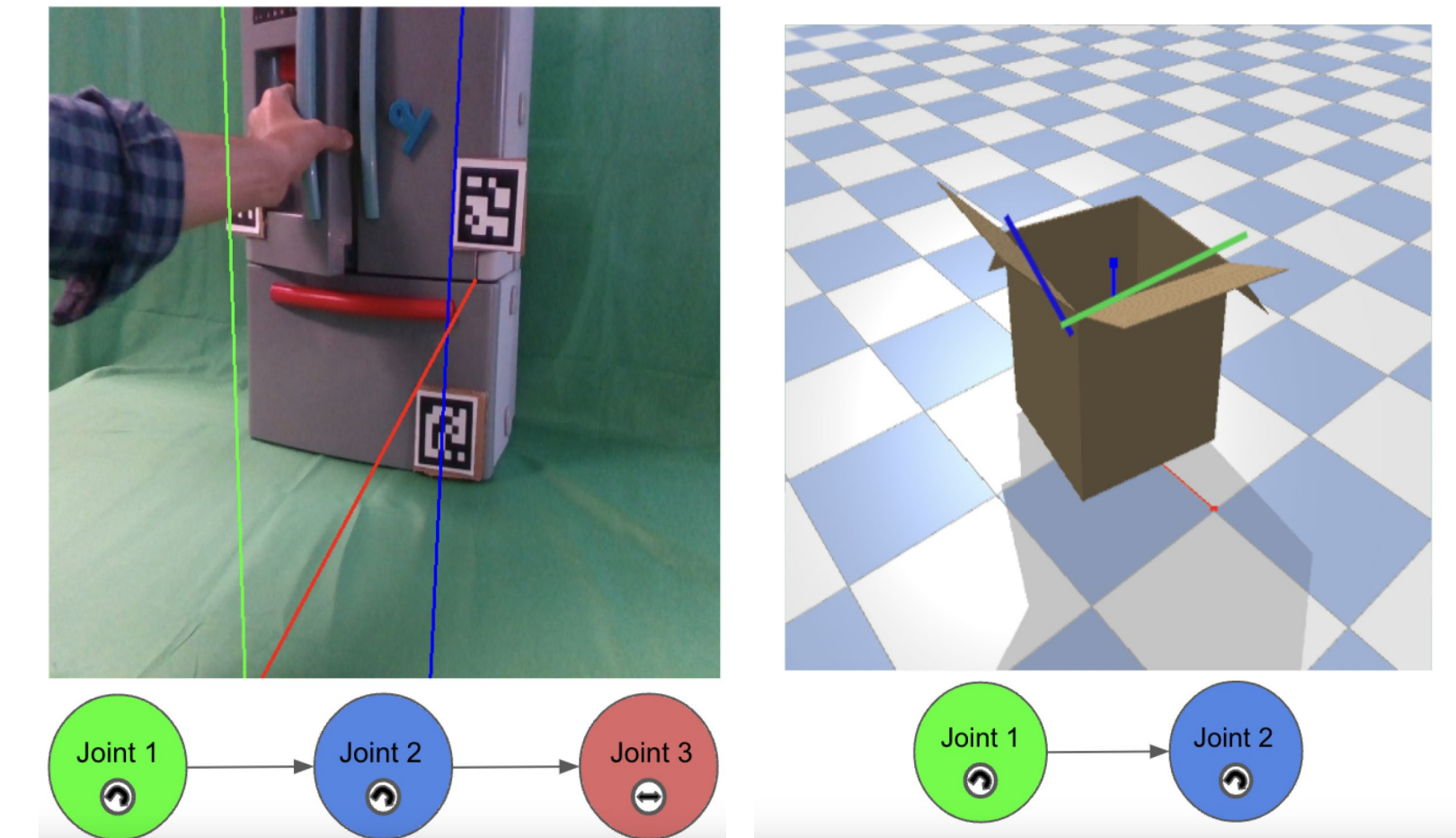


## Methodology:

- Sequence of point clouds for input.
- Learns the features using a point cloud encoder.
- Learns temporal data using a sequential model.



## Results:



Object	Axis 1 Position	Axis 2 Position	Axis 3 Position
Microwave - Baseline*	28.834 ± 1.94	-	-
<b>Microwave - Ours</b>	<b>21.293 ± 1.65</b>	-	-
Fridge - Baseline*	32.193 ± 1.873	33.571 ± 2.267	33.926 ± 2.178
<b>Fridge - Ours</b>	<b>24.144 ± 1.655</b>	<b>26.273 ± 1.744</b>	<b>25.337 ± 1.957</b>
Drawer - Baseline*	34.239 ± 2.135	-	-
<b>Drawer - Ours</b>	<b>28.253 ± 1.976</b>	-	-
Dishwasher - Baseline*	25.032 ± 1.782	37.239 ± 2.372	-
<b>Dishwasher - Ours</b>	<b>21.568 ± 1.612</b>	<b>30.836 ± 1.902</b>	-

Object	Axis 1 Direction	Axis 2 Direction	Axis 3 Direction
Microwave - Baseline*	30.702 ± 2.493	-	-
<b>Microwave - Ours</b>	<b>22.047 ± 1.424</b>	-	-
Fridge - Baseline*	32.96 ± 2.077	31.809 ± 1.715	35.923 ± 2.169
<b>Fridge - Ours</b>	<b>24.022 ± 1.286</b>	<b>21.173 ± 1.322</b>	<b>26.056 ± 1.462</b>
Drawer - Baseline*	35.284 ± 1.874	-	-
<b>Drawer - Ours</b>	<b>23.986 ± 1.366</b>	-	-
Dishwasher - Baseline*	27.923 ± 1.016	33.722 ± 2.275	-
<b>Dishwasher - Ours</b>	<b>21.16 ± 1.144</b>	<b>27.084 ± 1.631</b>	-