Characterization of Textile Grasping Experiments

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***Abstract*— Grasping highly deformable objects, like textiles, is an emerging subject of research that involves both perception and manipulation abilities. As new techniques appear, it becomes essential to design strategies to compare them. However, this is not an easy task, since the large state-space of textile objects explodes when coupled with the variability of grippers, robotic hands and robot arms performing the manipulation task. This high variability makes it very difficult to design experiments to evaluate the performance of a system in a repeatable way and compare it to others. We propose a framework to allow the comparison of different grasping methods for textile objects.**

Instead of measuring each component separately, we therefore propose a methodology to explicitly measure the vision-manipulation correlation by taking into account the throughput of the actions. Perceptions of deformable objects should be grouped into different clusters, and the different grasping actions available should be tested for each perception type to obtain the action-perception success ratio. This characterization potentially allows to compare very different systems in terms of *specialized actions*, *perceptions* or *widely useful actions*, along with the cost of performing each action. We will also show that this categorization is useful in manipulation planning of deformable objects.

Fig. 1. Different grasp configurations can be combined with different grasping point selection methods.

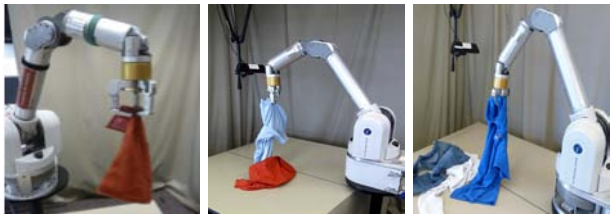

Fig. 2. A manipulator robot grasping several pieces of cloth using different gripper configurations and perceptions. Other variables used are the approaching point and the grasping height with respect to the grasping point delivered from perception.

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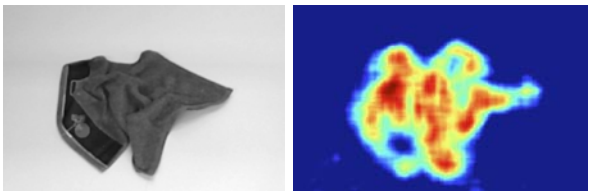

Fig. 3. Perception: wrinkledness detector delivers a heat map indicating most wrinkled parts that are good candidates as grasping points.

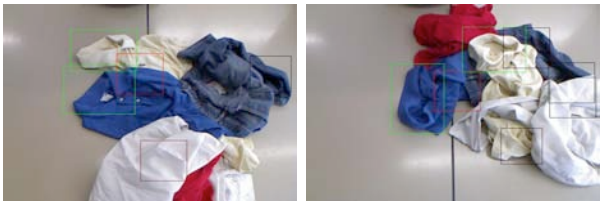

Fig. 4. Perception: a polo collar detector is used to find this distinctive part in the image. Grasping at this known part speeds up the task of leaving the cloth in a known configuration as specialized actions can be triggered.

References

[1] A. Ramisa, G. Alenya, F. Moreno-Noguer, and C. Torras, "Determining Where to Grasp Cloth Using Depth Information," in *Catalan Conference on Artificial Intelligence*, pp. 199-207, 2011.

[2] A. Ramisa, G. Alenya, F- Moreno-Noguer and C. Torras, "Using Depth and Appearance Features for Informed Robot Grasping of Highly Wrinkled Clothes" in *IEEE International Conference on Robotics and Automation (ICRA)*, 2012.

[3] F. Moreno-Noguer, "Deformation and Illumination Invariant Feature Point Descriptor", in *Conference in Computer Vision and Pattern Recognition (CVPR)*, pp. 1593-1600, 2011.

		Number of objects present				
		0	1	2	3	4
Number of objects taken	0	100	20	20	30	30
	1	0.0	80	50	30	50
	2	0.0	0.0	30	30	20
	3	0.0	0.0	0.0	10	0
	>3	0.0	0.0	0.0	0.0	0

TABLE I

COMPUTED PROBABILITY DISTRIBUTION OF SUCCESS IN GRASPING A SINGLE PIECE OF CLOTH IN PRESENCE OF DIFFERENT NUMBERS OF CLOTHES. THE HAND IS IN ISOMETRIC FINGER DISTRIBUTION AND PERCEPTION USES THE GRASPING POINT DETERMINED BY THE WRINKLEDNESS DETECTOR. GRASPING HEIGHT IS LOW. THIS PERCEPTION-ACTION COUPLE IS NOT VERY *specialized*, AS GRASPING A SINGLE OBJECT IN PRESENCE OF ONE OBJECT IS ONLY ACCOMPLISHED 80% OF TIMES, AND GRASPING TWO CLOTHES WHEN ONLY ONE IS DESIRED IS VERY PROBABLE ALSO.