Robot Design Lab WiSe 2020 Shiyao Zhang
Group 7

Worksheet 6

Solutions:
Due Date: 08.02.2021

Exercise 6.1

Mechanics of 3D Printing

Comparison of advantages and disadvantages of the different manufacturing processes

Solution

Various forms of 3D Printing

FDM

(Fused Deposition Modeling)
Pros:
1.It has lowest price of part costs and materials and it also has simple designs.
2.A wide variety of thermoplastic materials and exotic filaments can be printed with relatively few upgrades and modifications.

Cons:
1.It has lowest resolution and accuracy. It's not a best option for printing complex designs or parts with intricate features.

SLA

(Stereolithography)
Pros:
1.It's a relatively fast production.
2.The costs of materials is lower, because it has no wasted materials.
3.It has higher accuracy, the clearest details and the smoothest surface. So it is a good option for complex models.

Cons:
1.It was limited to photosentitive resin.

2.Parts are easier be affedted by moistruem heat, and chemicals.
3.Equipment operation and maintenance costs are high. Liquid resin materials and laser are expensive and needed a regular adjustment.

SLS

(Selective Laser Sintering)
Pros:
1. It's faster than SLA. Since the nylon powder used in SLS only required very breif exposure to the laser to be sintered, SLS printing has the potential to be one of the fastest 3D printing technologies.
2. It has low cost per part, high productivity and no support structures.

Cons:
1. The material is just laser and polymer powder.
2. It produces a lot of waste.
3. Equipment of SLS printer is most expensive among FDM, SLA and SLS.
4. The end result has a rough surface.

Additive manufacturing vs. Substractive Manufacturing

Additive manufacturing

Pros:
1.It's a very cheap process, because the most parts are complete using 3D printing.This manufacturing process can reduce costs on materials, because it only uses the amount of material required for the part itself with little or no wastage.
2.Because addictive manufacturing uses 3D printer, it has a rapid prototyping. And it has also a direct digital manufacturing, that means this process are used to create parts form virtual CAD models. It's much faster than moulded or machined parts.
3.The weight of the product can be up to 84% lighter than a product that has not been made using additive manufacturing technologies.

Cons:
1.The equipment of 3D printing is too expensive. The equipment of 3D printing is expensive to buy. Avoiding the costs on the projects could balance the costs.
2.The whole proces is a slow process, even though some steps could complete with 3D printing.
3.Some materials with low melting point like non-thermoplastic, wax, etc. were limited.
4.The end result has a rough surface. That needs a extra sanding or blowing.

Substractive manufacturing

Pros:
1.Processes are faster than additive manufacturing.
2.Wide variety of materials can be processed.
3.The end result can be machined like smooth, stepped,etc.

Cons:
1.It is expensive to use for small products runs.
2.It takes much more effort and time to set-up the machine, program the machine and then finally to create the object.

Exercise 6.2

Pinhole Camera Model

Suppose:
A focal length: $f = 150mm$
A height of A: $h_A = 30cm$
A distance between A and the camera: $d_A = 20m$
A projection of B: $p_B = 5$ pixels = 5 mm
A distance between C and the camera: $d_C = 35m$
A projection of C: $p_C = 15$ pixels = 15 mm

What is the size of the projection (in millimeters) of object A in the focal plane?

Solution

Because $d_A = 20m$ and $f = 150mm$, $d_A \gg f$,

then $\frac{1}{f} = \frac{1}{d_A} - \frac{1}{e} \Rightarrow \frac{1}{f} \approx \frac{1}{e} \Rightarrow f \approx \ e$

$\frac{p_A}{h_A} = \frac{f}{d_A} \Rightarrow p_A = \frac{f}{d_A} h_A$

$p_A = \frac{f}{d_A} h_A = \frac{150mm}{20m} * 30cm = 2.25mm$

What is the height (in meters) of object C in the real world?

Solution

Because $d_C = 35m$ and $f = 150mm$, $d_C \gg f$,

then $\frac{1}{f} = \frac{1}{d_C} - \frac{1}{e} \Rightarrow \frac{1}{f} \approx \frac{1}{e} \Rightarrow f \approx \ e$

$\frac{p_C}{h_C} = \frac{f}{d_C} \Rightarrow h_C = \frac{d_C}{f} p_C$

$h_C = \frac{d_C}{f} p_C = \frac{35m}{150mm} * 15mm = 3.5m$

What are the height and distance of object B from the camera?

If you think this cannot be computed, what kind of information do you need to make this computation?

Solution

The height of B and the distence between B and camera cannot be computed. We need to know the height of B or the distance of B and camera and then compute the other with the above equations.

Exercise 6.3

Robot Perception Tasks

Which computer vision task can be used for this purpose? Please justify your selection.

Solution

Localization can be used for this purpose. Our purpose is, that the social robot find the position of humans in each of its cameras. Localization is not only to produce a class label as in image recognition but also a bounding box that describes where the humans are in the picture. Computer could per the bounding boxes to know where is its target.

Which computer vision task can be used for this purpose? Please justify your selection.

Solution

Image classification can be used for this purpose. This task involves assigning a label to an entire image or photograph. The particular features of humans can be regarded as a label using to determine which one should be detected by computer. With those labels we could classify all images according to differet label like red clothes, long hair etc. in different catagories. It's seems like a database named huamn and stores alle informations about human. And then the computer could sift in those catagories and select a particular human who has all giving labels.

What kind of computer vision challenges do you expect to have while performing the two above tasks?

Solution

For the localization, we will have more than one bounding box for each target object. We have to determine which one is the most suitable. Even though for a same object, more detailed classification will cause the boxes overlapped with each other.

For the classification, it's difficult on variable scales of classes. One object could be assigned with so many different labels. Different labels could also refer to a same object. At same time a image dataset probably has more than millions images and more than 10 thousands classes. We need to train a fast and accurate visual classifier. It could recognize instance of extremly varied classes.

Feedback

How much time did you spendon doing this sheet per person

8 hours.

Was is too easy, easy, ok, hard, too hard?

Summarize the different manufacturing process.

What additional resources(blogs, papers, books, tutorials, etc) did you use?

https://www.commonlounge.com/discussion/c9975025c9ff473c8f9ed2c4b1c3ea6a
https://machinelearningmastery.com/applications-of-deep-learning-for-computer-vision/
https://www.3de-shop.com/additive-vs-subtractive-manufacturing-difference-pros-cons/
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html
https://formlabs.com/blog/fdm-vs-sla-vs-sls-how-to-choose-the-right-3d-printing-tech

Any other issue?