【机械臂视觉抓取教程】
第6讲 上位机与机械臂通讯--以UR为例

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日期　2022/11/9

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优傲机械臂 TCP/IP 通讯端口介绍

e-Series							
	Primary		Secondary		Real-time		Real-time Data Exchange (RTDE)
Port no.	30001	30011	30002	30012	30003	30013	30004
Frequency [Hz]	10	10	10	10	500	500	500
Receive	URScript commands	-	URScript commands	-	URScript commands	-	Various data
Transmit	See attachment from the bottom		See attachment from the bottom		See attachment from the bottom		See RTDE Guide

CB-Series							
	Primary		Secondary		Real-time		Real-time Data Exchange (RTDE)
Port no.	30001	30011	30002	30012	30003	30013	30004
Frequency [Hz]	10	10	10	10	125	125	125
Receive	URScript commands	-	URScript commands	-	URScript commands	-	Various data
Transmit	See attachment from the bottom		See attachment from the bottom		See attachment from the bottom		See RTDE Guide

上位机编程端口（30001/30002/30003端口）

端口	端口描述
502	Modbus TCP协议，机器人作为服务器
22	SSH/SFTP (安全文件传输协议)
29999	Dashboard功能
30001	第一客户端端口，自动返回机器人状态与补充消息
30002	第二客户端端口，自动返回机器人状态与消息
30003	实时反馈端口，自动返回机器人状态与消息，125Hz实时反馈接口

参考：https://blog.csdn.net/qq_38880380/article/details/100649711

1 通讯原理简介--接收信息

30003端口

Meaning	Type	Number of values	Size in bytes	Gnuplot col.	Notes
Message Size	integer	1	4		Total message length in bytes
Time	double	1	8	1	Time elapsed since the controller was started
q target	double	6	48	2 - 7	Target joint positions
qd target	double	6	48	8 - 13	Target joint velocities
qdd target	double	6	48	14 - 19	Target joint accelerations
I target	double	6	48	20 - 25	Target joint currents
M target	double	6	48	26 - 31	Target joint moments (torques)
q actual	double	6	48	32 - 37	Actual joint positions
qd actual	double	6	48	38 - 43	Actual joint velocities
I actual	double	6	48	44 - 49	Actual joint currents
I control	double	6	48	50 - 55	Joint control currents
Tool vector actual	double	6	48	56 - 61	Actual Cartesian coordinates of the tool: (x,y,z,rx,ry,rz), where rx, ry and rz is a rotation vector representation of the tool orientation
TCP speed actual	double	6	48	62 - 67	Actual speed of the tool given in Cartesian coordinates
TCP force	double	6	48	68 - 73	Generalised forces in the TCP
Tool vector target	double	6	48	74 - 79	Target Cartesian coordinates of the tool: (x,y,z,rx,ry,rz), where rx, ry and rz is a rotation vector representation of the tool orientation
TCP speed target	double	6	48	80 - 85	Target speed of the tool given in Cartesian coordinates
Digital input bits	double	1	8	86	Current state of the digital inputs. NOTE: these are bits encoded as int64_t, e.g. a value of 5 corresponds to bit 0 and bit 2 set high
Motor temperatures	double	6	48	87 - 92	Temperature of each joint in degrees celsius
Controller Timer	double	1	8	93	Controller realtime thread execution time
Test value	double	1	8	94	A value used by Universal Robots software only
Robot Mode	double	1	8	95	Robot mode see DataStreamFromURController
Joint Modes	double	6	48	96-101	Joint control modes see DataStreamFromURController (only from software version 1.8 and on)
Safety Mode	double	1	8	102	Safety mode see DataStreamFromURController
	double	6	48	103 - 108	Used by Universal Robots software only
Tool Accelerometer values	double	3	24	109 - 111	Tool x,y and z accelerometer values (software version 1.7)
	double	6	48	112 - 117	Used by Universal Robots software only
Speed scaling	double	1	8	118	Speed scaling of the trajectory limiter
Linear momentum norm	double	1	8	119	Norm of Cartesian linear momentum
	double	1	8	120	Used by Universal Robots software only
	double	1	8	121	Used by Universal Robots software only
V main	double	1	8	122	Masterboard: Main voltage
V robot	double	1	8	123	Masterboard: Robot voltage (48V)
I robot	double	1	8	124	Masterboard: Robot current
V actual	double	6	48	125 - 130	Actual joint voltages
Digital outputs	double	1	8	131	Digital outputs
Program state	double	1	8	132	Program state
Elbow position	double	3	24	133 - 135	Elbow position
Elbow velocity	double	3	24	136 -138	Elbow velocity
TOTAL		139	1108		139 values in a 1108 byte package

参考：https://blog.csdn.net/qq_38880380/article/details/100649711

1 通讯原理简介--发送指令

UR机器人有3种编程方式：Polyscope编程、脚本编程以及C-API编程

- Polyscope编程：指的是程序在示教器上被编辑，机器人然后执行，这是UI层的编程方式；
- C-API编程：是在研发层上的编程方式；
- **脚本编程**：URScript，是UR公司在Python语言基础上，自己研发的语言，是在脚本层上控制机器人的编程语言，我们使用的主要是这种脚本编程。

至于如何完成**接收信息**和**发送指令**，我们下节课会具体讲，本节课只通过发送一条简单指令，完成通讯测试

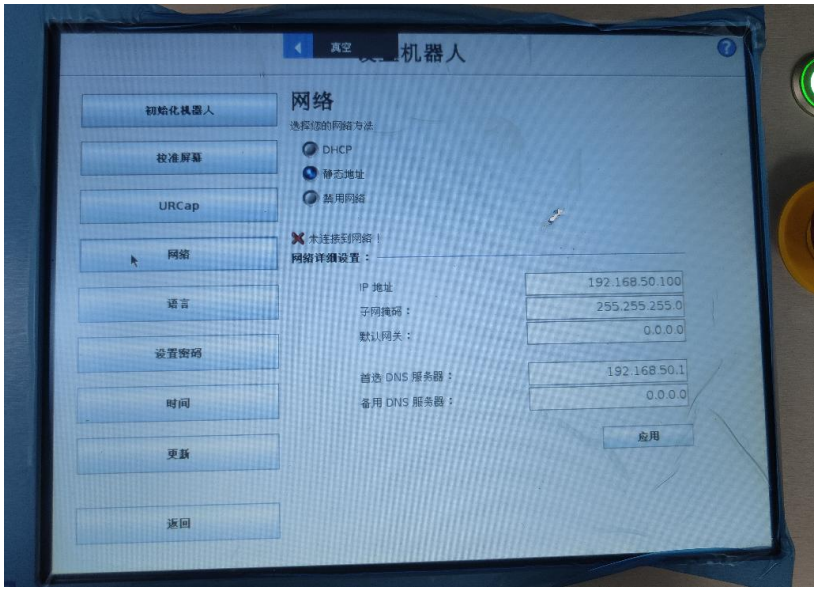
参考：https://blog.csdn.net/qq_38880380/article/details/100649711

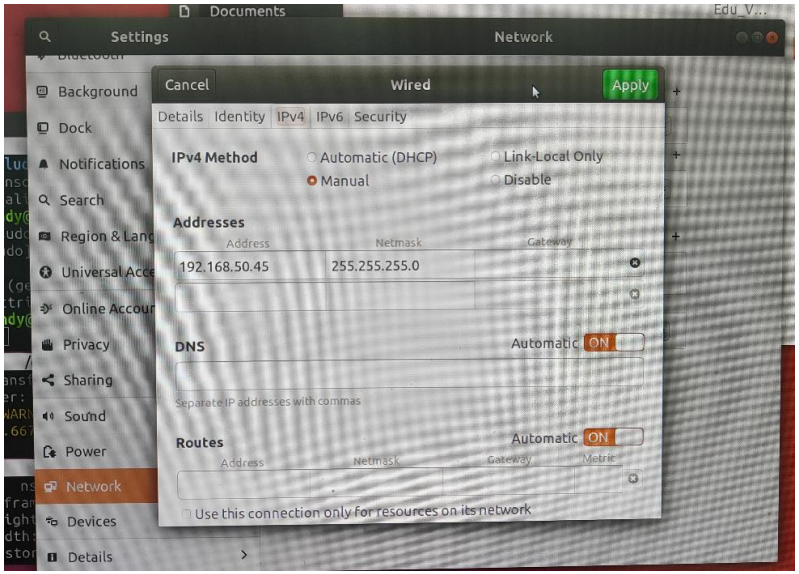
2 通讯操作

第一种(简单):

- 直接将机械臂的网线插入电脑
- 在机械臂示教器中修改IP地址
- 在PC端修改IP地址

技巧：查看PC端IP地址，然后设置到机械臂示教器里，只最后一位不同即可



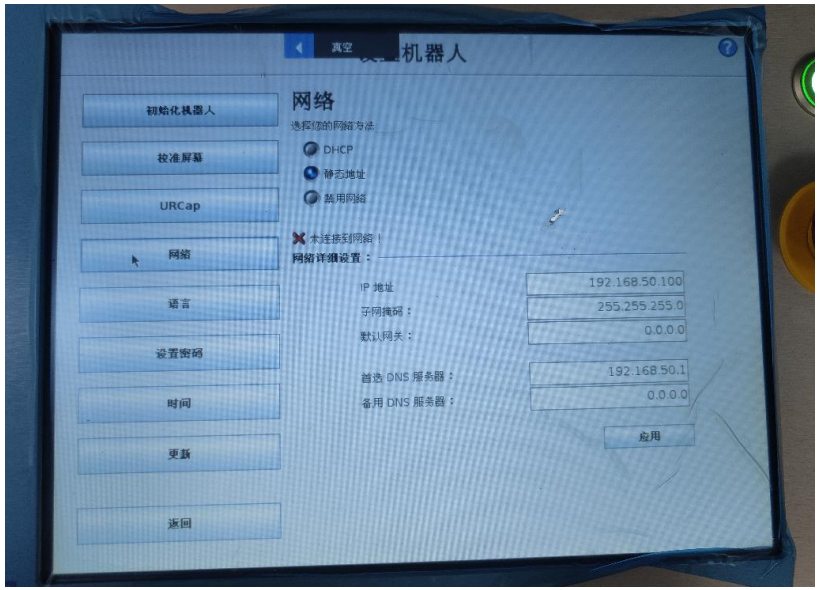


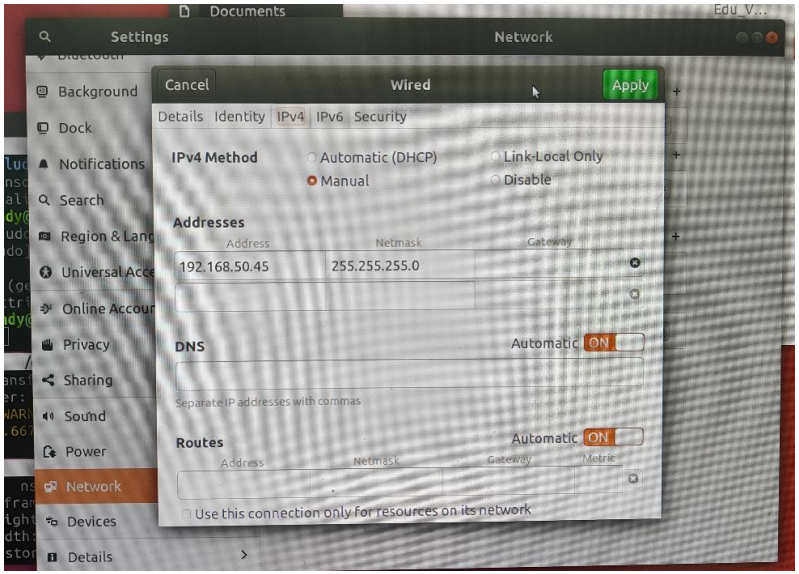
2 通讯操作

第二种(适合PC与机械臂距离较远)：

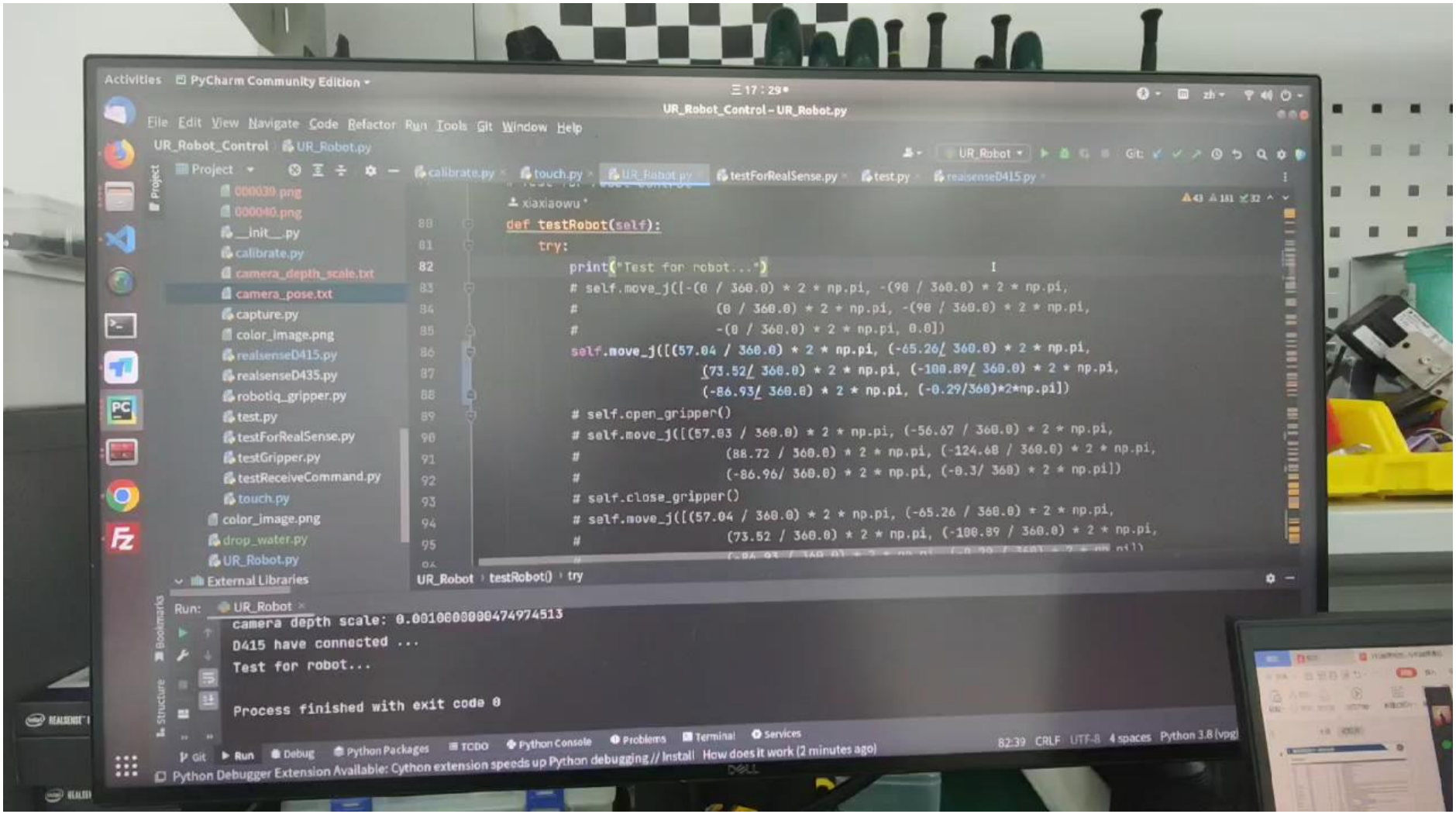
- 将机械臂的网线插入路由器，电脑连接该路由器（即连WIFI）
- 在机械臂示教器中修改IP地址
- 在PC端修改IP地址

技巧：查看PC端IP地址，然后设置到机械臂示教器里，只最后一位不同即可

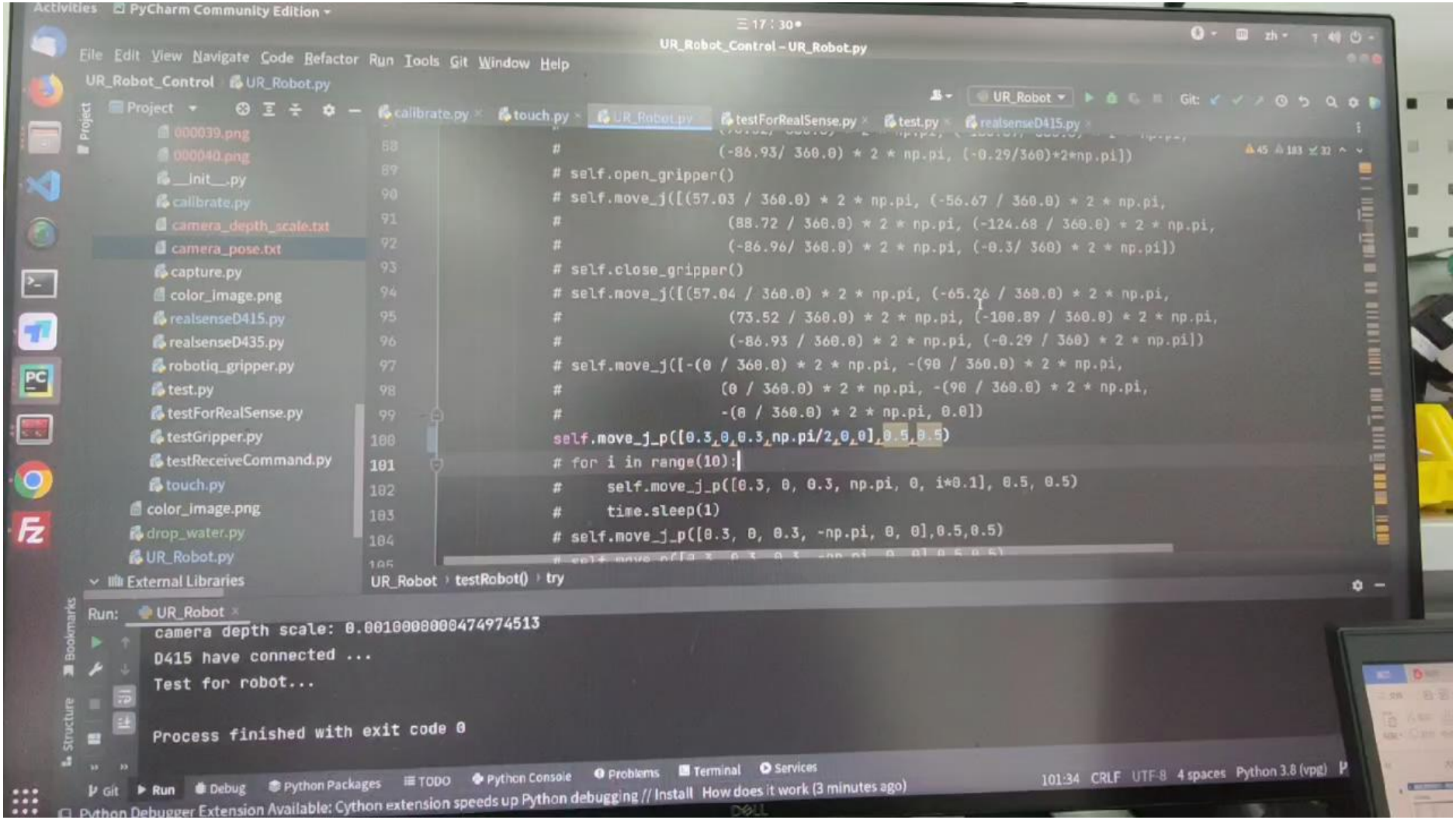




movej指令演示1：输入六个关节的角度



movej指令演示2：输入笛卡尔坐标系xyzrpy位姿



视觉抓取教程目录(暂定)

- **算法部分：**平面抓取姿态估计
  - 教程1：概述
  - 教程2：项目环境搭建与模型训练
  - 教程3：GRCNN代码讲解
- **视觉部分**
  - 教程4：手眼标定--眼在手外
  - 教程5：像素位置到实际坐标的转换--相机内参解释
- **控制部分**
  - 教程6：上位机与机械臂通讯--以优傲机器人为例
  - 教程7：机械臂编程实现对机械臂的控制
  - 教程8：GRCNN项目部署讲解--代码开源
- **机器人方向学习路线**
  - 补充教程：本人学习路线分享

机器人方向学习交流群

该二维码7天内(11月16日前)有效，重新进入将更新

特点：偏工程、偏基础

本人水平有限，如有讲错，

请在评论区批评指正！！