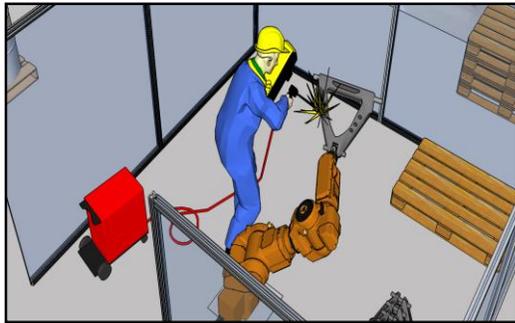


# Impedance control as an approach to manipulation of collaborative robots

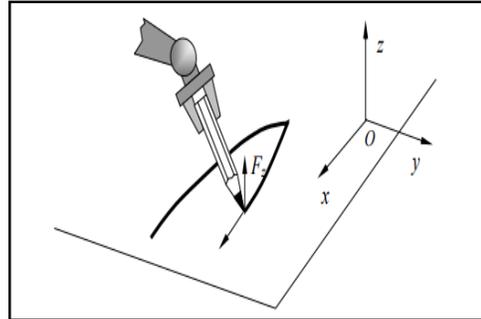


**Professor S.K.Saha**  
Department of Mechanical Engineering  
IIT-Delhi (<http://mech.iitd.ac.in/content/saha-sk>)  
**Research Areas** : Multi body dynamics, Robotics ,  
Design, Mechatronics

**Professor I.N.Kar**  
Department of Electrical Engineering  
IIT-Delhi (<http://web.iitd.ac.in/~ink/>)  
**Research Areas** : Non linear systems, Contraction  
theory , Robotics , Robust optimal control ,  
Control of Multi-agents systems



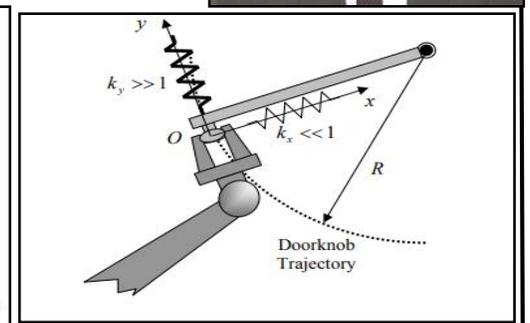
Robot assisting a human in a collaborative environment ,interaction forces need to be controlled precisely to ensure safety.



Robot drawing a line with a pencil on a sheet of paper with *hybrid/force position control*  
Desired motion trajectory in X-Y Plane and force trajectory along Z-axis



Interaction of robot with a human requires intelligent control of the interaction forces



Robot opening a door with *variable Impedance control*  
Setting desired directional *stiffness and damping (impedance)* in null space of motion control



**Udayan Banerjee**  
B.Tech (EE) (WBUT)  
M.Tech (EE)  
(NIT Durgapur)

PhD Research scholar  
SIRe,  
IIT-Delhi  
<https://www.linkedin.com/in/udayan-banerjee-7a00a963/>

Interaction of robots with environment and human has focused attention of researchers in the field of robotics. Collaborative robots are meant to work hand in hand with human beings in a shared workspace. Safety is a major concern when robots and human beings work in a combined workspace. Safe interactions may be ensured through impedance or compliance control. Programmable directional impedance will help in programming a desired path in cobotic action of the robot arm based on the operator's impedance and effort. Online identification of human intent and human impedance will be required for cobotic operations. Impedance control is essential in situations where manipulators have to interact with environment. The environment here may be treated as admittance and the manipulator as the impedance. Rigorous mathematical modelling of the mechanical systems and use of advanced control strategies to get desired actuation (simultaneous impedance variation and motion control) and applications of detection, identification and estimation techniques will constitute the research work.