REACTION PAPER

Robots are well integrated into the human society from minor tasks such as flipping the burgers to performing surgeries. The speaker was able to effectively communicate the need to make robots adapt effectively in an imperfect, uncontrolled and dynamic environment by drawing an analogy between animals and robots. Animals including tend to adapt to survive in a difficult environment. Examples of how the robots should behave or imitate animals was mentioned by the speakers at different levels. The analogy between the scrub nurse and the robot in the OR need to understand how human brains works. The Inhibitory and Excitatory signals worked similar to a 'yes' or 'no' in a human brain. Another interesting example included the development of sensors based on 'whisker sensing technology' which imitated the features from the animal kingdom such as long sensing range, highly flexible, high sensitivity.

The flow of the presentation was effective which started from the raising the question of 'How to make the robots adapt effectively' and ended with the requirements for useful adaptation. The growth of the research was effectively presented in terms of graphical representation of Cognitive and Technical Autonomy and the outcomes. The first stage where the author presented the condition where there is low cognitive and low technical autonomy included the case of Robot assisting in the OR. The next stage as the author moved up the adaptability line included the 'See and do system. The third stage as explained by the author included the highest amount of autonomy. The first two stage included the medic assisted by robots be it in the form of scrub nurse, or using drones as the medium to connect the mentee and the mentor. The final stage needed the robot to be more autonomous as it places the robot in the main role and the doctors assisting the robot remotely. The example mentioned by the author mentioned war-like conditions with detonations. The robots are expected to adapt to conditions even when there is no vision. The example of 'Taurus' using perception, material, shape and chemical analysis on the spot well demonstrated the need for cross-coupling of fields such as biology, material engineering, computational engineering etc.

Various videos played by the speaker served dual purpose one, understand the real-world scenario and also highlighting some of the issues which might crop up in the real world. Consider the video of doctors with the robotic assistant- the need for speed and robot to be able to predict the next instrument in need was seen. This might be improved through adjusting the weights of the spike timing neural network. Any delay might reduce the efficiency of the robot, and would just fulfill the role of filling in for scarce human resource. For it be able to actually replace a scrub nurse there is a need for it to move up the adaptability curve. The animated image of mentors discussing and annotating surgical regions which is further projected for the mentee initially through an tab- highlighted the issue of it coming in the way and the need to improve. The speaker mentions the AR head mounted display which solves the issue of the tab coming in the way. The cognitive capabilities of the mentee need to be able augment the see-and-do-system through other approaches such as projecting on to a wall which can act as an aid to the mentee. The field demonstration of drones sending the videos directly to the mentors seems ideal without many drawbacks. The view stabilization image helped highlight the real time need of computer vision and image processing for a better diagnosis in time of 'golden hour'. Demos of robots performing peg transfer when submerged in blood, surgical debridement served as examples of the fact that robots can do better which can be measured in terms of the cognitive load. The measurement of cognitive load served as a quantitative measurement of the performance of the robots in terms of

cognitive autonomy. Video of robotic arm sucking blood from different points almost imitated the real-world scenarios but still has a long way to go.

The adaptability graph showed the interaction of human and robots moving up the curve. However, with the reducing ratio of doctors to humans, teachers to students there is need to dissociate the humans and robots. To do so there is a need for increased autonomy both in terms of cognitive load and technical aspects. Robots can be trained using ample data to learn from the doctors, and deployed in the real world. There is another dimension which needs to be explored which involves ‘Ethics in robotic autonomy’ especially in cognitive autonomy section. When dealing with issues such as ‘golden hour’ the decisions taken by the robots become quite crucial. Transparency, autonomy become the base pillars on which the decisions need to be taken. In case of negligence or errors doctors can be held accountable. In the scenario of robots performing surgeries, it can only improve its performance by learning from the current conditions and no accountability on its part. This could also lead to another dimension in the robotic-horror domain.