Task 3

A brief description of the paper:

The paper is about discussing the use of cochlear implants as prostheses by people suffering from sensorineural deafness. The aim is to talk about all kinds of useful models and to discuss the advantages and disadvantages of them and modify them as per the requirements. The proposed model is compared with all sorts of circumstances and is then modified and studied further.

Pros:

- ★ Great progress has been achieved in the area because of the idea of cochlear implants.
- ★ A computational model using artificial neural networks (ANN) to incorporate the natural phenomena in the artificial cochlear.
- ★ The ANN model presents a series of advantages to the implementation of such systems, they are;
    - ❏ First, the hardware requirements, with constraints on power, size, and processing speeds, can be taken into account together with the development of the underlining software, before the actual neural structures are totally defined.
    - ❏ Second, the ANN model, since it is an abstraction of natural neurons, carries the necessary ingredients and is a close mapping for implementing the necessary functions.
    - ❏ Third, some of the processing, like sorting and majority functions, could be implemented more efficiently, requiring only local decisions.
    - ❏ Fourth, the ANN model allows function modifications through parametric modification (no software recoding), which permits a variety of fine-tuning experiments, with the opinion of the patients, to be conceived.
- ★ The results of some new experiments such as the use of the neural model are encouraging, and point to the fact that cochlea implants need only minor improvement to be able to mediate ad-lib speech perception successfully.
- ★ The improvements observed are of undeniable value in improving speech perception.

Cons:

- ★ Unfortunately, only partial acoustic information is obtained by severely deaf patients with a cochlear prosthesis.
- ★ Useful patterns for speech communication are not yet 'fully recognizable through auditory prostheses.
- ★ The model has been implemented as an off-line process, but it is not easy to define the amount of feedback needed in the system or the amount of time dispersion.
- ★ Another variance in the experiment is the amount of damage (and type) among different individuals. So, these parameters have to be determined clinically.
- ★ Since one cannot control the amount of damage in the system of each patient or differences in individuals, it is hard to predict the ideal values for a given patient.
- ★ The use of the no-contact inductive coupling method. The drawback of this method is that all the information has to be compressed in a single channel for reliable transmission and cross-talk elimination.

Technical errors and updates:

- ★ The technical errors in the paper that I could think of were I guess the problem with the choice of patients. Basically, the test would be different for different people, and as it would be hard for us to exactly come to the conclusion there should be some alternative way that should be followed. It could be the population divided into various categories on the basis of age, sex, etc. so that it can give better results and much better performance in both the cases discussed.
- ★ Another technical error could be getting confused between the single and multi-channel implant. The multi-channel implant should be applied on the modified implant model only because after doing so it can give better results. The ultimate goal is to create a multi-channel and so it should be done after modifying the single implant so as to work with proper knowledge and experience.
- ★ The data they used was not shown here, As the result and its basis was not very clear.
- ★ Since the inductive coupling of the implant· is critical at every cycle, the most relevant information must be picked out of the processed signal.

Directions for future research:

- ★ Since the inductive coupling of the implant· is critical at every cycle, the most relevant information must be picked out of the processed signal. This information is then given all the available energy, and after all the coupling loss, it should be sufficient to provide for speech pattern discrimination. In a multichannel setting, this corresponds to doing a sorting of all the n signals in the channels, selecting the 'm' highest signals, and adding them up for modulation. In a naive single processor implementation, this could correspond to n2 comparisons, and in a multiprocessor implementation, log(n) comparisons.

Both are dependent on the number of signals to be sorted. **We need a scheme wherein the sorting time would be constant with the number of channels and would be easily implementable in analog circuitry, in case this became a future route.**

- ★ We can soon start with the use of the first on-line portable model, using a single processor. This model will provide a testbed for more extensive clinical trials of the implant.
- ★ We can also move to the **parallel implementation, followed by the analog circuitry implementation**.
- ★ Further, neuromorphic computing can be used in a way by the use of sensory recordings from healthy animals to train self-organizing adaptive learning networks, in order to design the implant transfer functions.

References:

1. Bilger, R.C.; Black, F.O.; Hopkinson, N.T.; and Myers, E.N., "Implanted auditory prosthesis: An evaluation of subjects presently fitted with cochlear implants," Otolaryngology, 1977, Vol. 84, pp. 677- 682
2. House, W.F. and Urban, J., "Long term results of electrode implantation and electronic stimulation of the cochlea in man," Annals of Otology, Rhinology and Laryngology, 1973, Vol. 82, No.2, pp. 504-517
3. Miyamoto, R.T.; Myres, W.A.; Pope, M.L.; and Carotta, C.A., "Cochlear implants for deaf children," Laryngoscope, 1986, Vol. 96, pp. 990-996.
4. Wasserman, G.S., "Cochlear implant codes and speech perception in profoundly deaf," Bulletin of Psychonomic Society, Vol. (18)3, 1987.