Provide a summary (at least one page) of one concept in the paper that you found interesting?

High affinity of ligand for a receptor is used in biosensor devices. A biosensor consists of three elements, a bioreceptor, that could detect a specific ligand biding, a transducer converting the biological signal into an electrical signal, including an amplification and signal processing system. The detection device needs to meet a variety of stringent requirements; it needs to be fast, reagentless, self-regenerating, ultrasensitive; it also needs to have high accuracy, to be stable, robust, tolerated by the patients and produced at low cost. Biosensors are classified either by their biological signaling mechanism or by the type of their transducer. There are five main biological recognition mechanisms:
1) **Enzymatic based sensor**: the highly specific interaction between ligand and their receptors provides these sensors with a higher detection limit compared to other types of biosensors.
2) **immunosensors:** uses highly specific, and stable antigen-antibody binding properties. Optical and electrochemical detection methods are gaining momentum as promising tools in early detection of cancers.
3) **DNA/nucleic acid sensors**: a single stranded DNA (**ssDNA**) is used as a probe which when exposed to a complementary ssDNA, results in hybridization and the formation of double stranded DNAS (**dsDNA),** the biochemical reaction is then amplified by the transducer into an electrical signal. The nucleic acid recognition layer is reusable after DNA denaturation.
4) **Cell-based sensor:** this type of sensors contains microorganisms such as bacteria or fungi and relies on the ability of the cell to detect intracellular or extracellular microenvironment changes. Limit of detection of these detectors is determined by cell selectivity, and the ability of the cell to survive various environmental conditions. However, cell-based biosensors, are less sensitive to inhibition by solutes, suboptimal pH, ionic composition, and temperature compared to catalytic sensors.
5) **Biomimetic sensors or Aptamers**: are synthetic strands of nucleic acid designed to recognize peptides, oligosaccharides, amino acids and proteins. Due to their components, they are limited in structural and chemical sensing properties and they have higher production cost.
Biosensors are also categorized according to the transduction method: 1) **electrochemical** depending the nature of the electrochemical changes detected (amperometric, potentiometric, impedance and conductometric) 2) **calorimetric** based on heat exchange during the chemical or biological reactions 3) **piezoelectric** where a shift in signal frequency is correlated to the mass of the analyte to measure 4) **optical**. Optical based sensors are popular and allow real-time monitoring, one major issue is sensitivity to ambient light:

- **Surface plasmon resonance** (SPR) biosensors use plasmon waves to detect changes in refractive index at the sensor surface. It is a label free technique which does not require radioactive or fluorescent tagging compounds. They can detect binding by molecules up to 2 kDa.
- **Chemiluminescence biosensors**: reaction between the target and the immobilized molecule which has been tagged with chemiluminescence species, generates light detected by a photo multiplier tube (PMT). This tool, due to its simple instrumentation and fast response time, is widely adopted in immuno-sensing and nucleic acid hybridization.

- **Fluorescence based sensors**: an external laser initiates a transition in fluorochrome molecules which produce light during the biological event, the light is then transduced to an optical signal; e.g., nucleic acid or antibodies are tagged with fluorochrome and hybridization between two sDNAs is converted to an optical signal.
- **Optrodes**: include a light source, a biorecognition component, an optical fiber. The light is transmitted through the biochemical reaction and its reflection is measured by a spectrophotometer. These are miniaturized high performance sensors, with high sensitivity and low detection limits.

Biosensors are used in many scientific domains like medicine, life-science, and for environment protection, in the food industry and in military applications. However, when real-time monitoring is not a requirement, simple buffer solutions are used instead due to to their low complexity overhead and cheaper making. One promising future research is the development of disposable, easy to use at home biosensors for medical diagnostics avoiding laboratory analyses.

Note how your knowledge of receptor-ligand interactions could help you in determining a new approach for a biomedical engineering application