Biosensors with build-in logic for medical applications

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Abstract. The abstract should briefly summarize the contents of the paper in 150–250 words.
general concept
multisignal digital biosensors processing complex pattern of different physiological markers
practival considerations
challenges

Keywords: First keyword · Second keyword · Another keyword.

1 Introduction

overviw of the novel research paradigm of digitally operating biosensors logically processing multiple biochemical signals through Boolean logic networks composed of biomolecular systems

1.1 Use of biosensors

1.2 innovation

1.3 how das technique work

2 Chancen

- biomedical monitoring(example, closed-loop-¿ patient tailored timely therapy, personalized medicine= sensing devices + delivery devices)
  - closed-loop -¿ patient tailored timely therapy possible
  - sensing devices + delivery devices = personalized medicine
  - example feedback-loop: diabetes: electrochemical glucose sensing element + insulin-delivery feedback loop
  - fast delivery in emergencies
- environmental monitoring
- national defense
- food safety

3 concept

- unconventional computing = quelle
- biocomputing multiple biochemical coupling of signal processing with chemical actuators

3.1 Biocomputing

Definition

- single logic gates (mimicking Boolean) to small logic networks
- biomolecular systems for processing chemical information
- more complex than nonbiological systems
- coupling enzymatic reactions (logic gates) with electronic transducers and signal-responing materials

=¿enzyme logic gates

3.2 Examples

theoretical

- glucose oxidase and catalyse operating as logic gates:
- input : H2O2 and glucose
- gluconic acid = biocalatyltic oxidation of glucose
- only when both present opical output signal. = AND
- define logic values: small changes = 0 and large absorbance changes as 1 =¿ AND
- similar possible with XOR,AND, OR, NOR, INHIBIT
- with logic gates with modular structur that enables therir assembly in networks NAND/ NOR possible
- logic gates and their networks = biomolecular information processing systems
- =¿ biosensoric systems with logically processed signals represented by various biomarkers(characteristic of different abnormal physiological conditions)

example ph

- pH changes in solution as logic respones to input signals
- AND invertase + glucose oxidase (from 5.8 to 3.5)
- OR ersterase and glucose oxidase in glucose and ethyl butyrate - when one of both present -¿acidification
- neutral ph = 3,5

Conclusion:

- don't solve real computing problem nor operate as useful biosensors
- represent first step toward the development of digital biosensors
- funfact optimization of enzymatic reaction, up to 10 logic gates concatenated with low noise in the system

ENzyme logic system recognizing various injury-related physiological conditions

- types of injuries result in concentrations of chemical substances in the body

- example: lactate axidase, horeserasish peroxidase and glucose dehydrogenase = designed to process biochemical information related to pathophysiological conditions from brain injury
- markers: glucose(hemorrhagic shock),lactate(rhagic shock or traumic brain injury) and norepinephrine(traumatic injury)
- logic 0 = normal concentrations
- change results into different numbers 1,2,3 - convenient
- = biocomputing logic system
- challenge: difference between normal and unnormal minimal =¿ not linear, should be sigmoidal

4 challenges

prospects fundamental and practical challenges

- attention to composition, preparation and immobilization of the biocomputing surface layer
- sucess depends in part on immobilization of the biocomputing reagent layer
- system scalability
- efficient transduction of the output signals
- high fidelity

stuff missing
da war was mit wie viel knnen hintereinander geschaltet werden

4.1 Enzyme logic circuits-scaling up the system complexity

- main challend: scaling up the complexity of the systems by networking the individual parts of a logic circuit
- addressed experimentallly when designing networks composed of concatenated enzyme logic gates
- assembled logic networks analyzed theoretically for opimization and noise reduction; coupling output signals with electronic transducers and bioelectronic devices

4.2 Biomolecular logic gates designed for biomedical analytical applications

problems not addressed yet in biomolecular information processing systems:

- logic 0 values were defined as the absense of the enzymes
- logic 1 not always correspond to the concentration expected in vivo /not normal physiological concentrations
- input not justifies to their biomedical meaning

5 advantages

- multiple target analytes(inputs) (enzymgates)/biochemical inputs
- high-fidelity biosensing compared
- rapid and reliable assessment of physiological condition (enzymes + automatically provessing)
- optimal timely therapeutic intervention
- realization of closed-loop systems (sense/act/treat)
- missing example fields like diabetes (siehe text)

6 Conclusion

7 Idee des Aufbaus

- Abstract: Biosensoren, logic gates, possibilities, challenges and future work
- introduction Definition, possible fields(examples), special,... loops
- The idea Theory and practical
- Two examples
- Layers, challenges and future work
- conclusion

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