# INTRAPERITONEAL GLUCOSE SENSING – RAPID AND ACCURATE


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## MOTIVATION

### Why intraperitoneal sensing?

- **Subcutaneous glucose sensors:** Slow response, poor robustness towards local tissue effects (mechanical pressure, temperature etc).
- **Intravascular glucose sensors:** Not practically possible outside of the hospital/clinic.
- We need a rapid, accurate and robust glucose measurement for making a safe artificial pancreas.
- **Intraperitoneal glucose sensors** may react faster than subcutaneous sensors [1,2], while being more practically usable than intravascular sensors.

## METHODS

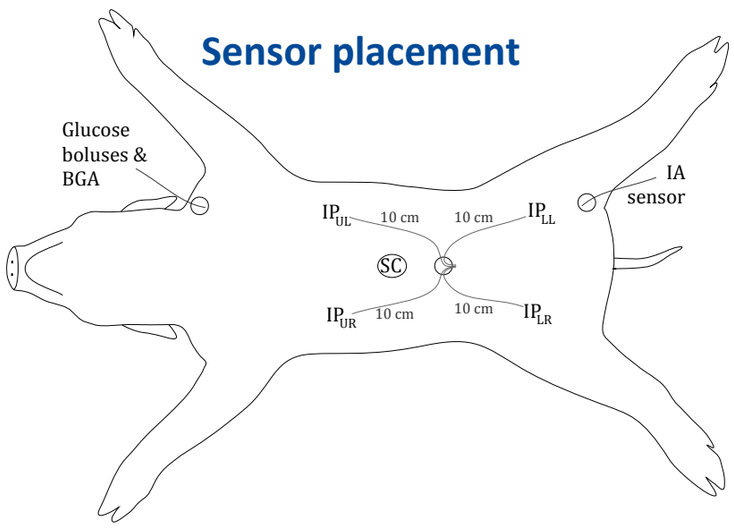
### Animal trials

- 3 anaesthetized non-diabetic pigs
- Intravenous infusion of glucose boluses
- Glucose level excursions within the range 5–22 mmol/L

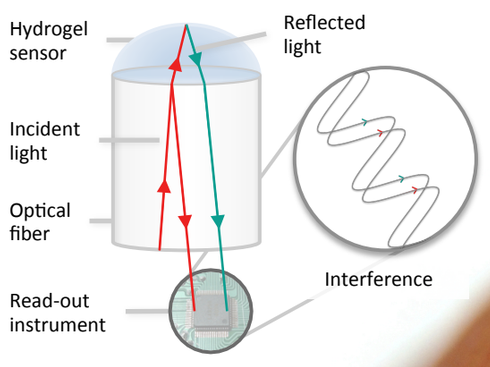
### Sensor types used in trials

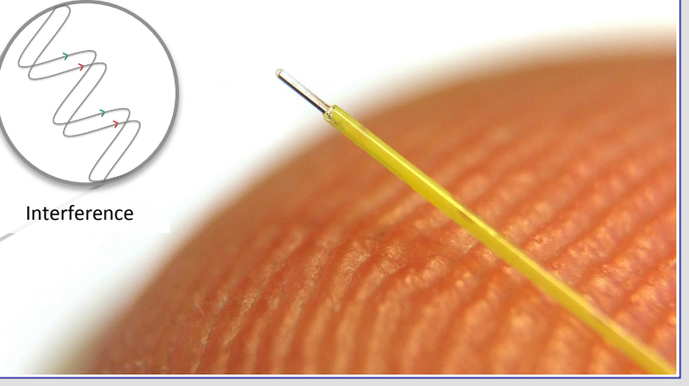
- **Intraarterial (IA):** Optical interferometric phenylboronic acid based sensors, placed in the femoral artery [3,4].
- **Intraperitoneal (IP):** Using the same sensor as in the IA case. Accessed from below the umbilicus through a common port, directed to 4 different positions (Fig. on the right). 2–4 sensors per animal.
- **Subcutaneous (SC):** Off-the-shelf amperometric enzyme-based (glucose oxidase) sensors. Placed on the belly, above the umbilicus.
- **Venous blood** was sampled and analyzed on a blood gas analyzer (BGA) for reference and calibration of the other sensors.

### Sensor placement



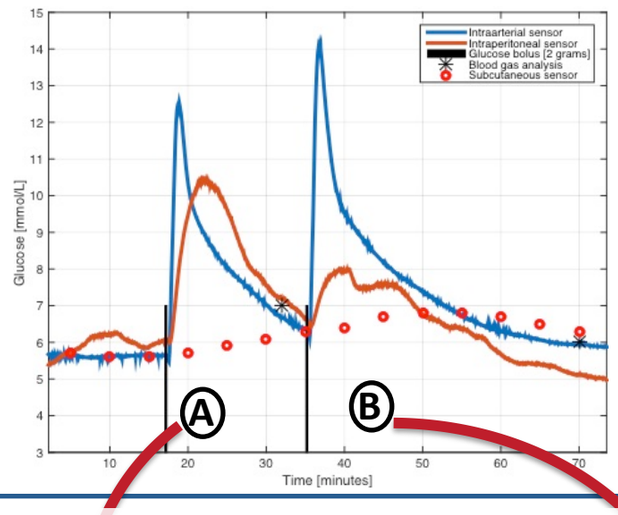

### Optical interferometric sensors

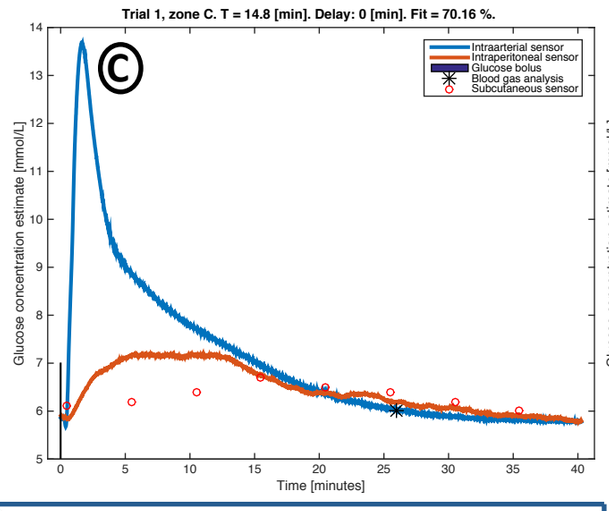


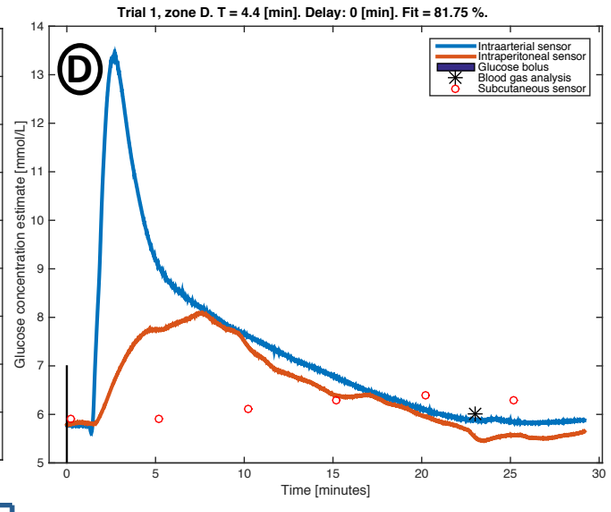



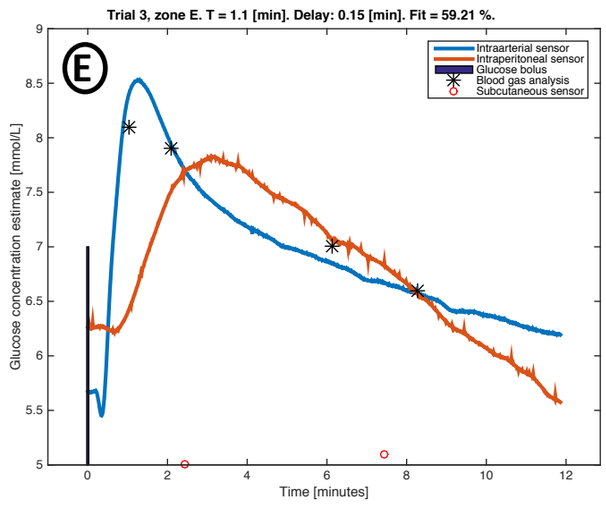
## RESULTS

### Examples from 6 segments:



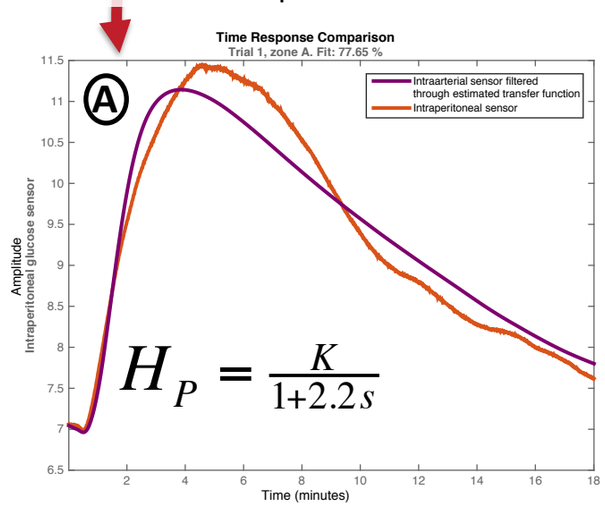



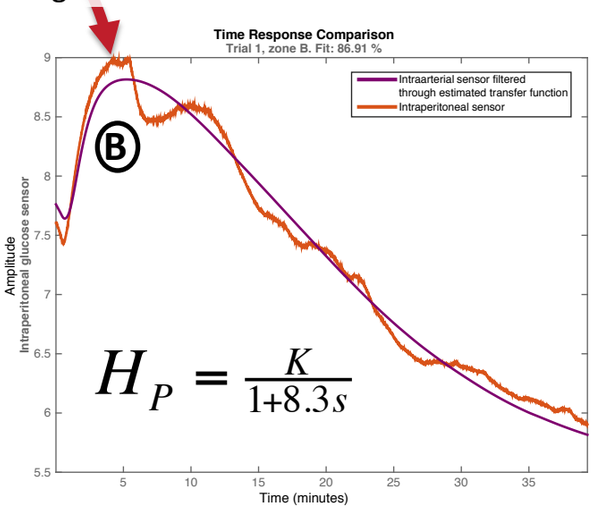



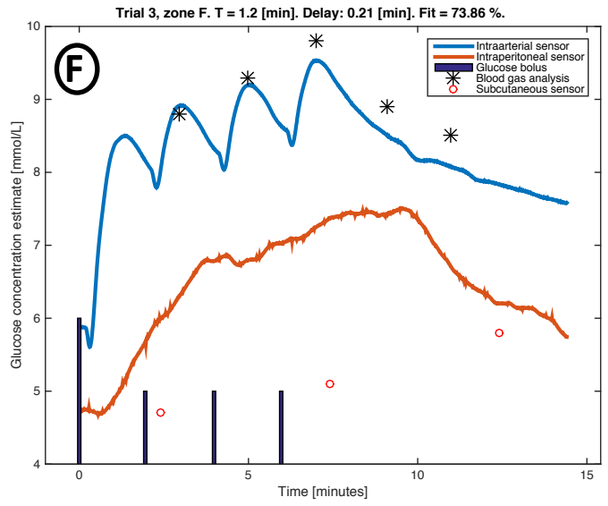




### Estimated linear transfer functions (from blood to peritoneum)

Based on relationship between IA and IP sensor signals.




### Summary

- 3 trials, 4–7 segments from each trial.
- **Time delays:** 0–15 seconds (median: 9.0 s, mean: 6.74 s, stdev: 6.76 s).
- **Time constants:** 1–15 min (median: 4.20 min, mean: 5.03 min, stdev: 4.05 min).

## CONCLUSION

- **Intraperitoneal glucose sensors** can have a substantially faster and more distinctive response than **subcutaneous sensors**.
- Our results indicate that IP sensors may react even faster than previously shown [2].
- Variable dynamics during the experiments + some sensors had to be relocated -> Need to investigate disturbances & sensor location in more detail.

## REFERENCES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