David Sinden
david.sinden@gmail.com
djps.github.io
djps | *david_sinden*

Constructor University gGmbH
Campus Ring 1
28759 Bremen

December 20 2023

Research Statement

Computational Topology

Let us cite all the books: [Bak10].

[Bak10] M. Baker. The book. *Journal*, 1:1–10, 2010.

Ultrasound & Thermal Therapies

The Right Dose In The Right Place

The typical dose model [Sin10]. A research program would focus on

- A foundational tool would be an open-source model for histotripsy [PGS+17]. This would be a time-domain finite-volume solver which would solve the with varying material properties, including significantly, phase-changes due to both boiling and acoustic cavitation. The nucleation of bubbles would be modelled via the peak-negative pressure. The reflected waves due to cavitation activity would present a computational challenge, as subvoxel resolution.
- A measure of dose would be due to the mechanical damage induced by both the acoustic wave and the bubble activity.
- The second measure of biological effect would be to model the expression of heat-shock proteins, via a systems biology approach.
- An approach to correlate bio-effects [GSM+22].

Quantitative Ultrasound

Typically image reconstruction and segmenting objects within the image are performed separately. However, in ultrasound, the most basic image formation approach neglects , so produces images with significant artefacts.

Recent *joint segmentation and reconstruction approach*. This is ideally suited to ultrasound. An implementation of the CUTE method coupled to the Chan-Vase equation. Such an approach would have impact for towards ultrasound imaging, thermometry as well as dosimetry.

[GSM+22] Pauline Coralie Guillemin, David Sinden, Yacine M'Rad, Michael Schwenke, Jennifer Le Guevelou, Johan Uiterwijk, Orane Orane Lorton, Max Scheffler, Pierre-Alexandre Poletti, Jürgen Jenne, Thomas Zilli, and Rares Salomir. A novel concept of transperineal focused ultrasound transducer for prostate cancer local deep hyperthermia treatments. *Cancers*, 15(1):163, 2022.

[PGS+17] Ki Joo Pahk, Pierre Gélat, David Sinden, Dipok Kumar Dhar, and Nader Saffari. Numerical and experimental study of mechanisms involved in boiling histotripsy. *Ultrasound Med. Biol.*, 43(12):2848–2861, 2017.

[Sin10] DM. Sinden. *Something else book*. Me, 2010.