Adaptation in the ventral cochlear nucleus in the presence of constant-amplitude tone bursts is determined by ordered inter-spike interval statistics

**Introduction**

The VCN is the first sound processing station in the mammalian brain and is crucial for hearing. Understanding its responses would allow a better understanding of all aspects of hearing.

With neurons show various different physiological and morphological aspects.

**Research questions:**
1. Can we understand the neurons response better using INTERVAL statistics (instead of spike times)?
2. Are spikes (intervals) independent of each other? (necessary for modelling and reconstruction of PSTH)
3. Can we reconstruct (model) neuronal responses compactly?
4. Can we define response class distinctions better?

**Methods**

For rhesus single cell recordings from the ventral cochlear nucleus of the urethane anesthetized guinea pig (Cavia porcellus).

- 72 ms rise/fall time and randomized starting phase at the unit's best frequency (BF) at 20 dB and at 50 dB (a subset of neurons) above threshold.
- Response types at both levels were classified by the third author according to the classification scheme by (Blackburn and Sachs 1989) into one of the following classes: 273 CS, 327 CT, 39 CL, 276 PN, 106 PL, 156 ON. Excluding 361 units showing phase-locking. Following 362 units at 20 dB of which 833 units were also measured at 50 dB, totalling 1376 measurements in which we obtained 250 repeats.

**Conclusions**

- Interspike interval statistics are useful
  - They offer a good description for the whole response
  - They contain the information to recreate every spike train, not just the PSTH
  - They allow to reconstruct the PSTH simple and exact.
  - Intervals are independent to all intents and purposes. A spike erases the memory of the previous interval. This is different from the LSO (Johnson, 1986!)
  - Neurons are counters (not clocks): adaptive behaviour depends more on the number of spikes than on the time since tone onset.
  - Class distinctions are nebulous when observed in the context of ISI statistics. A small change in one of the statistics can move a response from one class to another.
  - ISI description provides the means to describe (model) responses very simply and compactly (3n parameter, can be modelled with fewer)
  - First spikes are different from subsequent intervals.
  - We are now in a position to examine:
    - To what extent are the classes truly distinct?
    - Why do choppers chop?
    - What rules allow us to go from ISI statistics to response types? (automatic classification)
    - How does response depend on different stimulus attributes (amplitude, etc.)