Cardio-Respiratory System during Sleep : Cyclic Alternating Pattern (CAP) and Applications for Decision Support Systems.

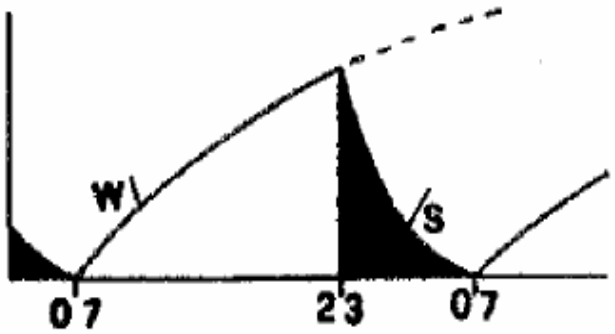
Martin Mendez

Outline

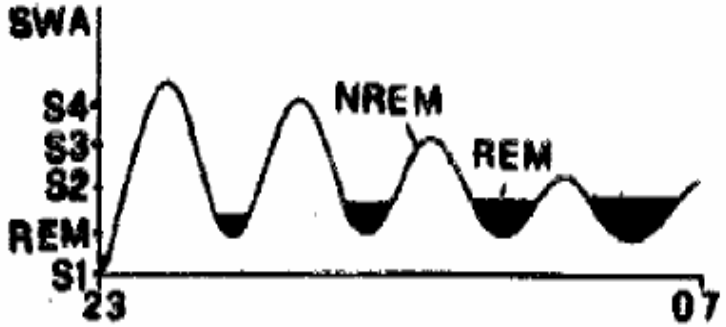
- Sleep
- Macrostructure
- Microstructure (CAP)
  - –Effects on Cardio-respiratory system
- DSS for Sleep Apnea

Sleep

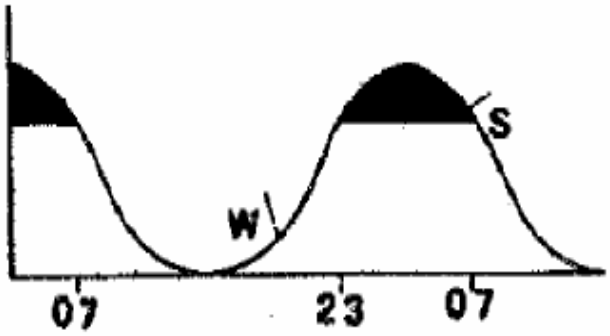
OMEOSTATICO



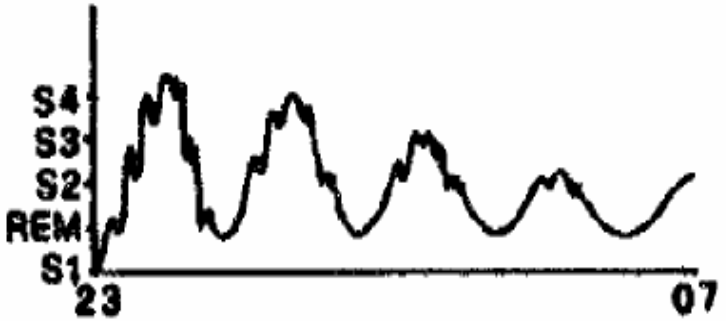
ULTRADIANO



CIRCADIANO

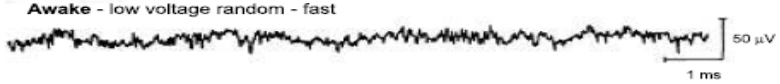


CYCLIC ALTERNATING PATTERN



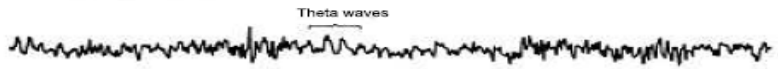
Macrostructure

Awake - low voltage random - fast

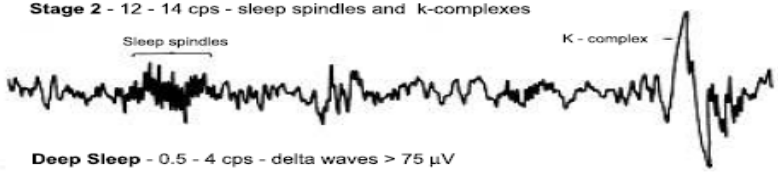


Drowsy - 8 to 12 cps - alpha waves

Stage 1 - 3 to 7 cps - theta waves

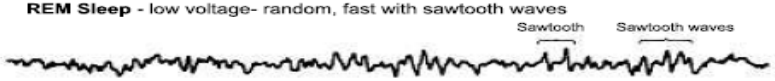


Stage 2 - 12 - 14 cps - sleep spindles and k-complexes



Deep Sleep - 0.5 - 4 cps - delta waves > 75 µV

REM Sleep - low voltage- random, fast with sawtooth waves



What CAP Sleep is

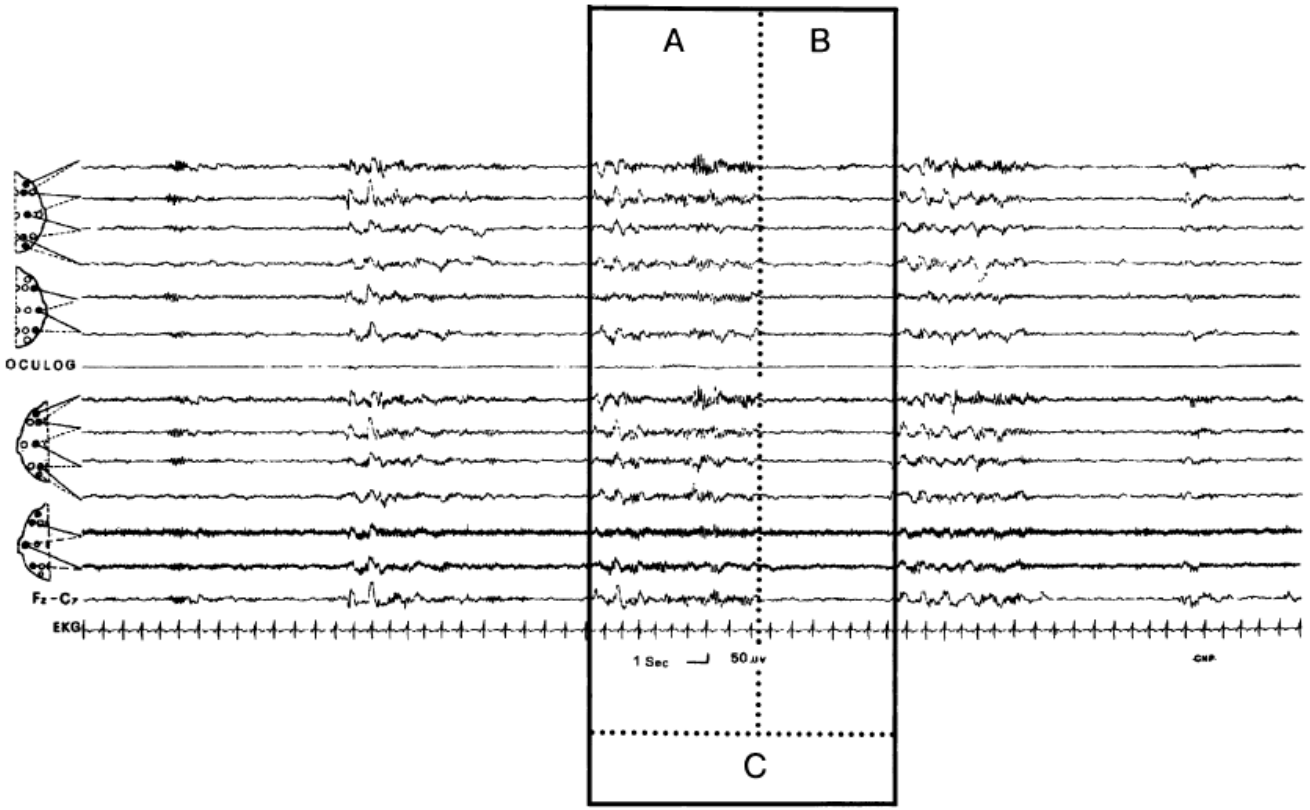


Fig. 1. An example of cyclic alternating pattern (CAP) in sleep stage 2. The box outlines a CAP cycle (C) composed of a phase A (A) and the following phase B (B). Bioplolar EEG derivations using international electrode placement; top 6 channels from top to bottom: FP_2–F_4, F_4–C_4, C_4–P_4, P_4–O_2, F_8–T_4, T_4–T_6; bottom 7 channels from top to bottom: FP_1–F_3, F_3–C_3, C_3–P_3, P_3–C_1, F_7–T_3, T_3–T_5, F_2–C_2; OCULOG: Oculogram; EKG: Electrocardiogram.

Terzano
2001

Players during CAP

CAP is characterized by sequences of transient electrocortical events that are distinct from background EEG activity and recur at up to 1 min intervals.

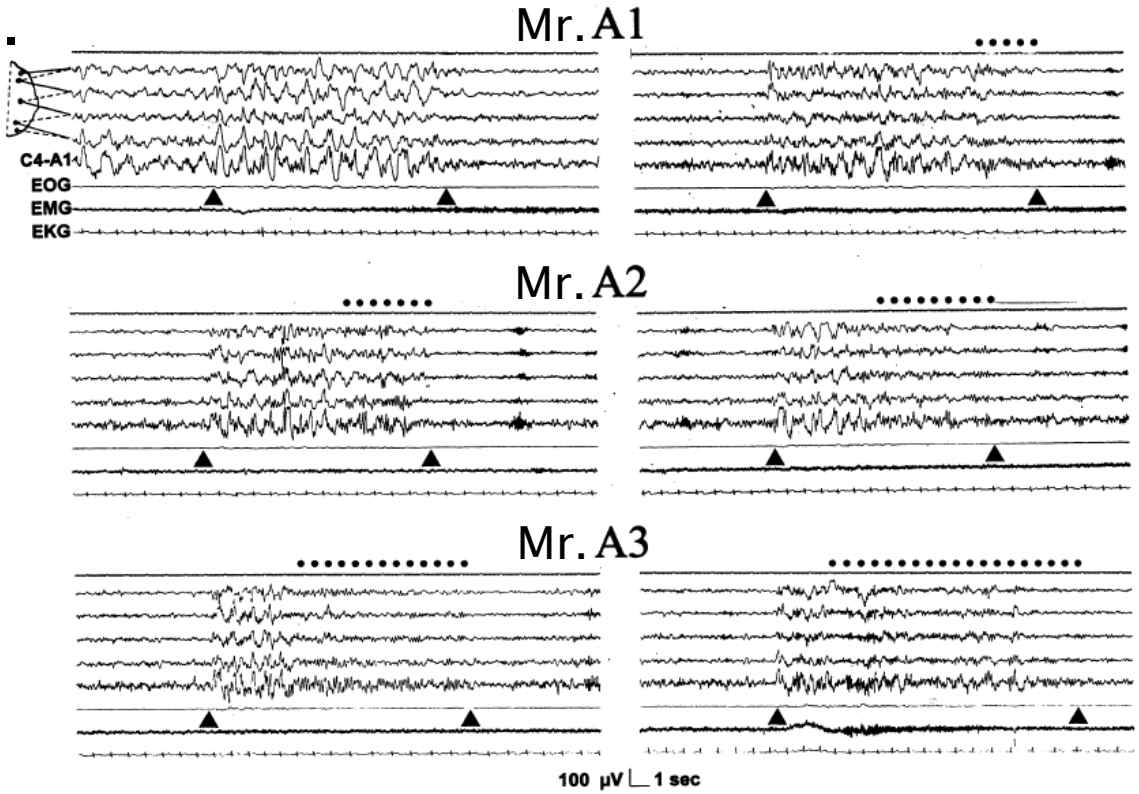
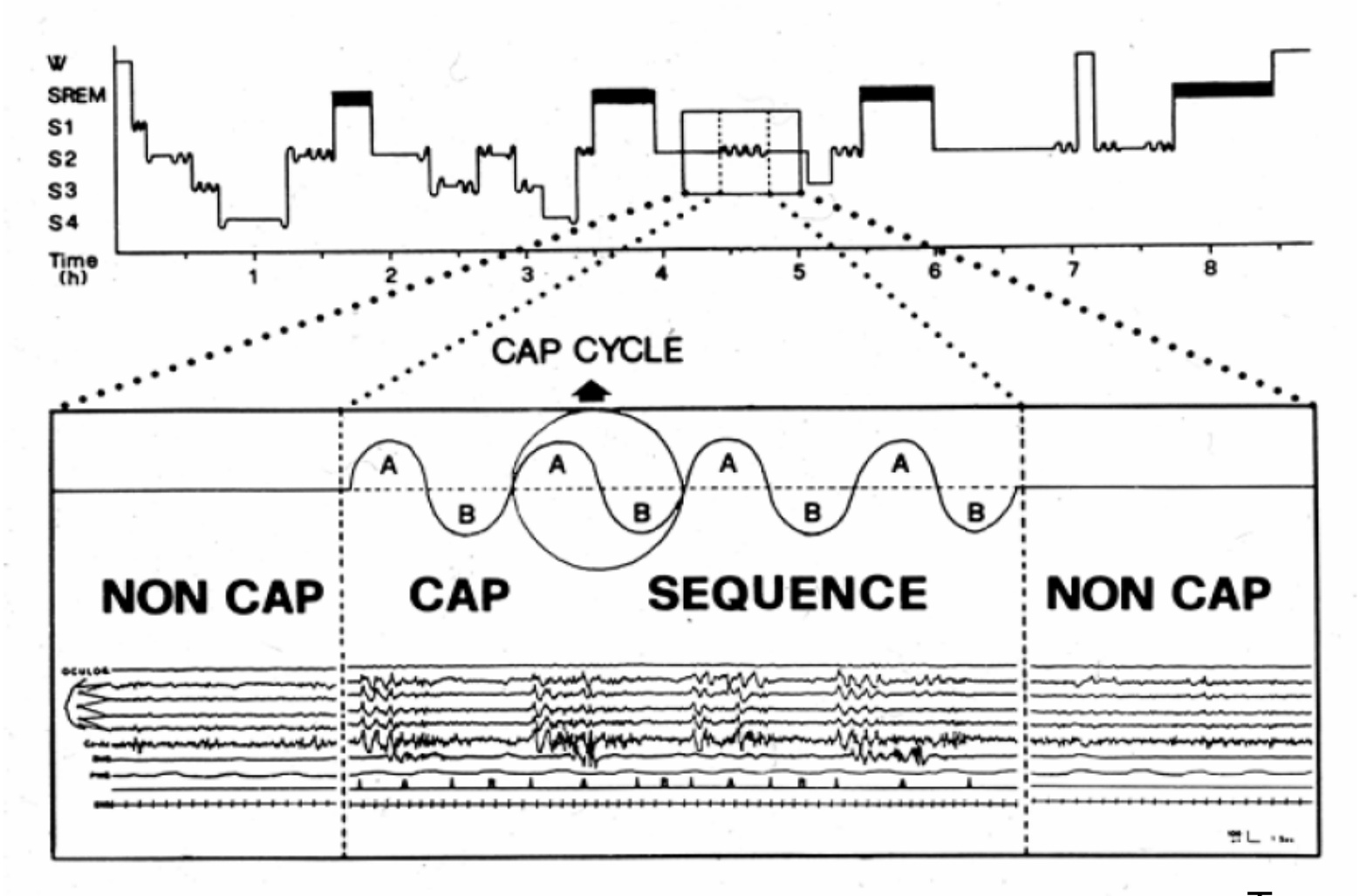


Fig. 17. Phase A subtypes. The dotted spots indicate the fast low-amplitude portion of the phase A. EEG derivation as in Fig. 2.

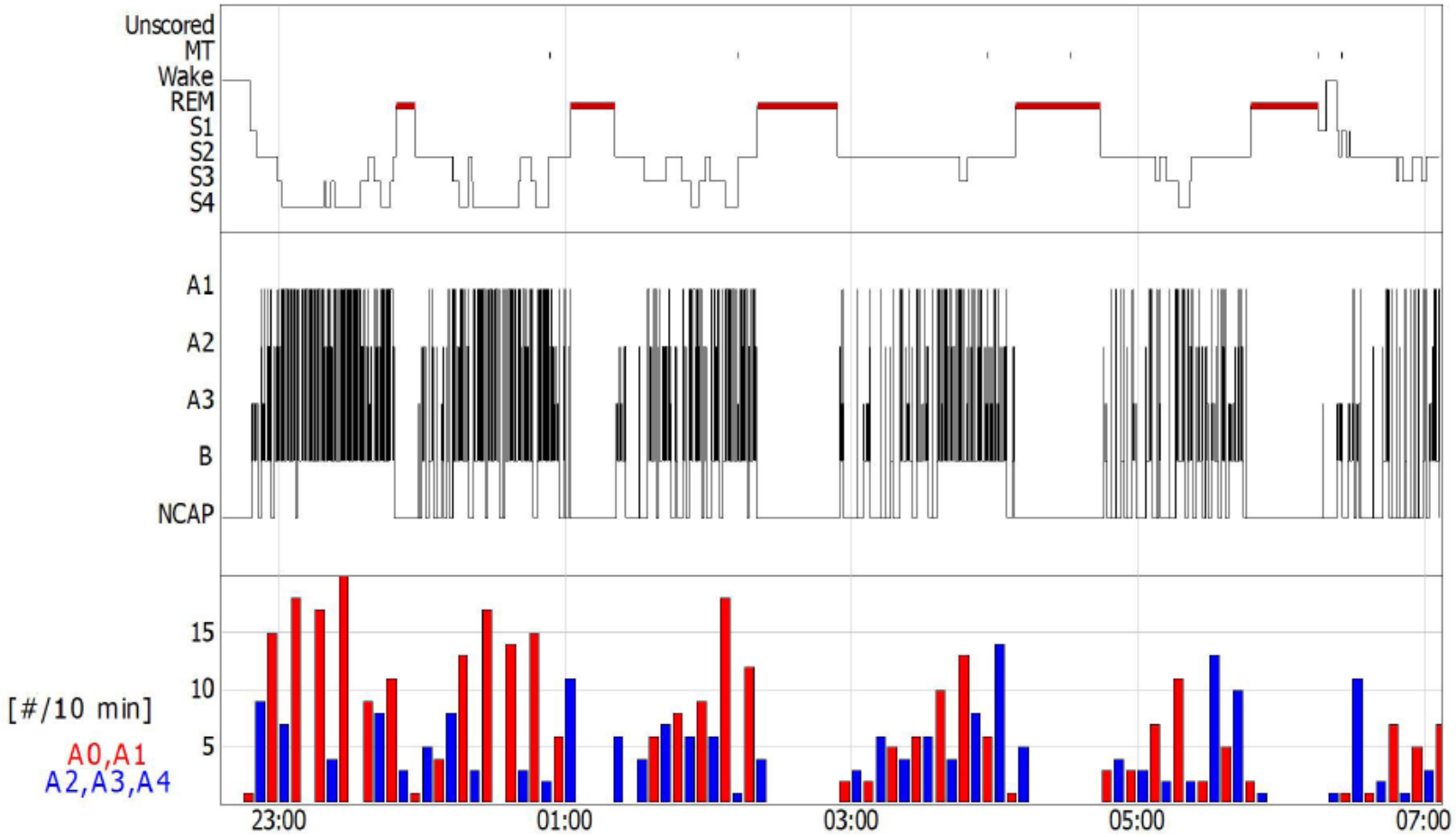
Terzano 2001

CAP Sequence

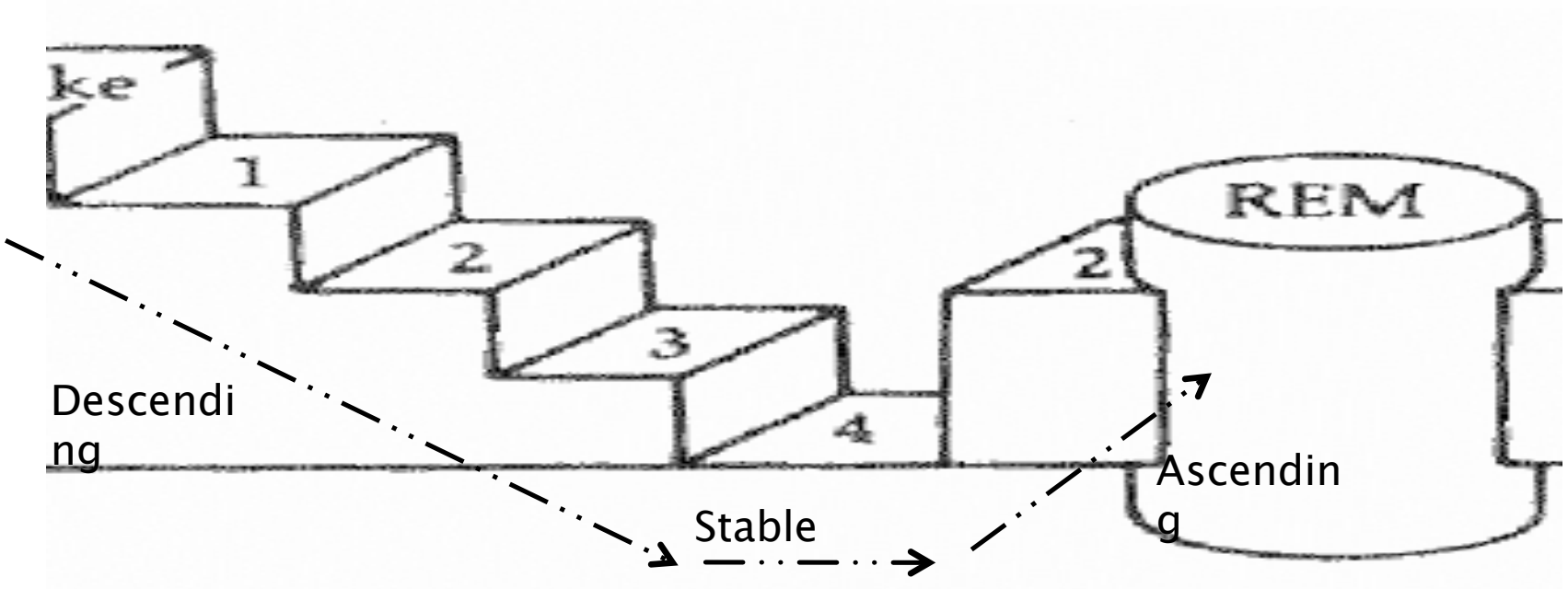


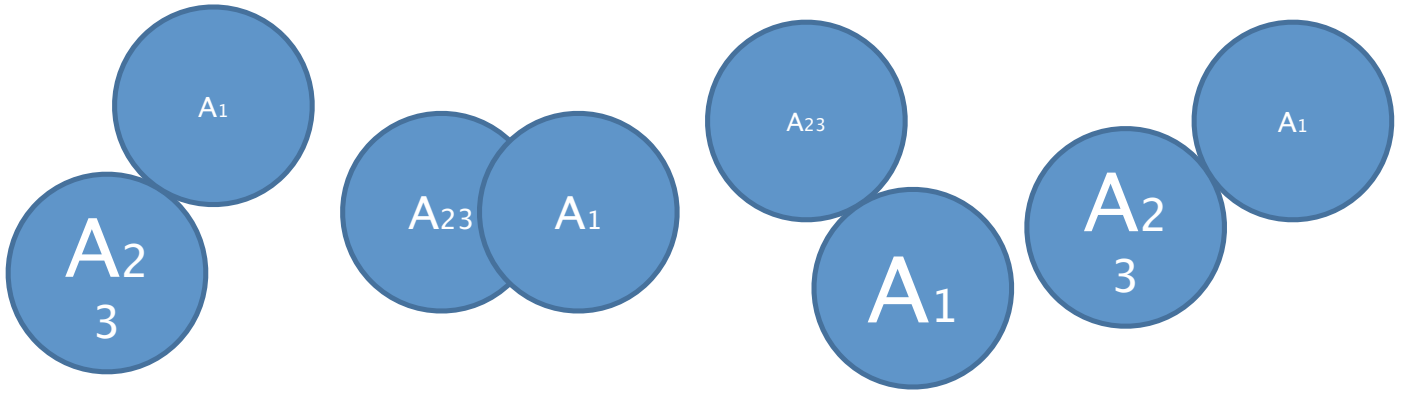
Terzano

CAP Analysis



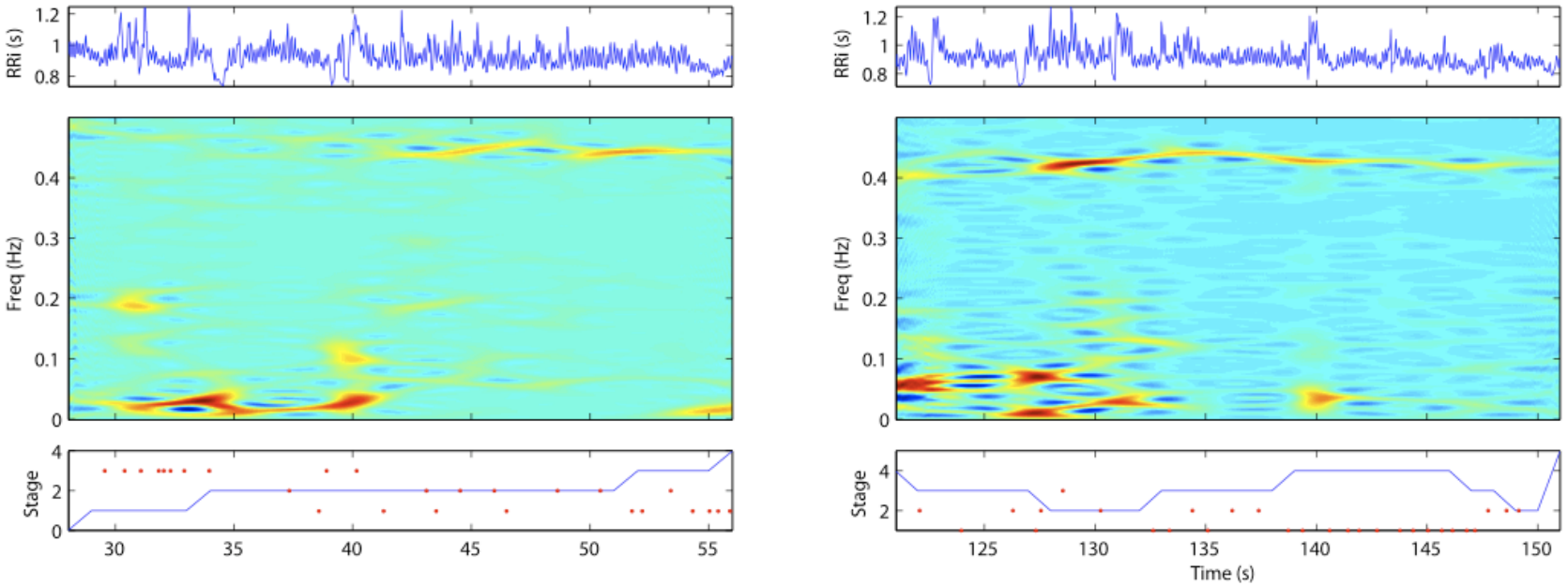
Mr. A_1 and Mr. A_{23}



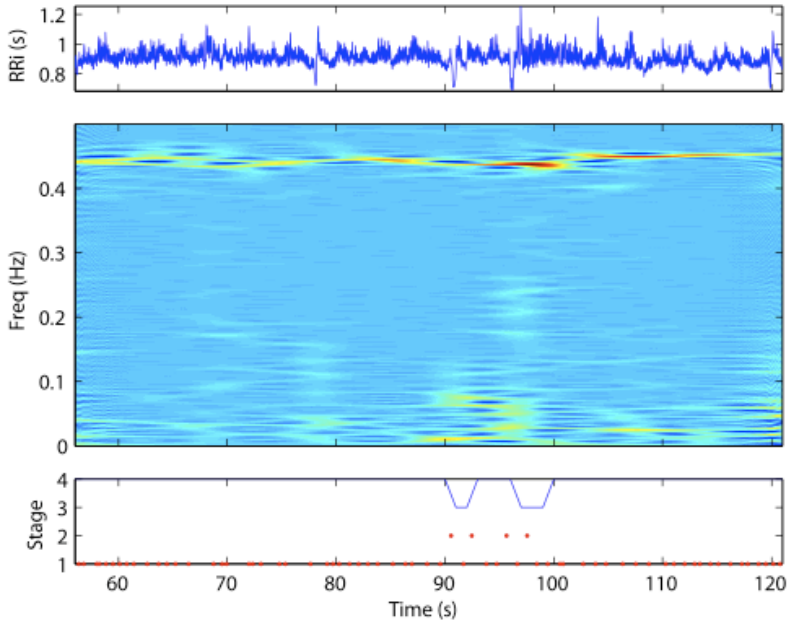


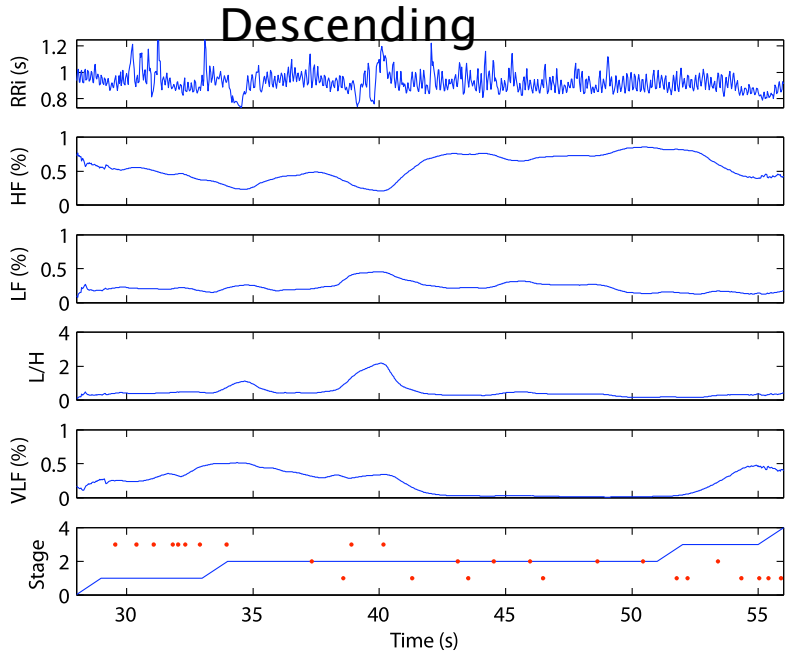
Descending

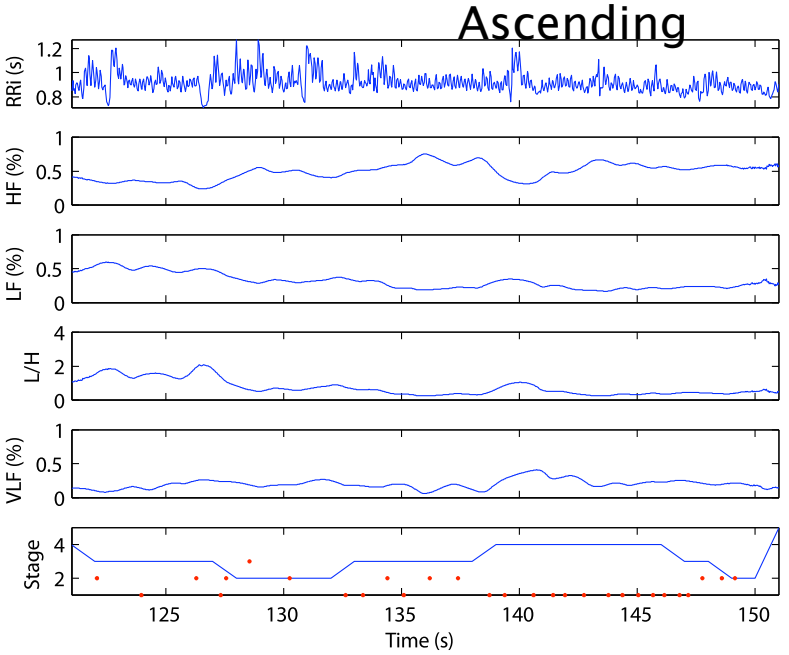
Ascending



Stable




Descending
RRi (s)
HF (%)
LF (%)
L/H
VLF (%)
Stage
Time (s)


Ascending
RRi (s)
HF (%)
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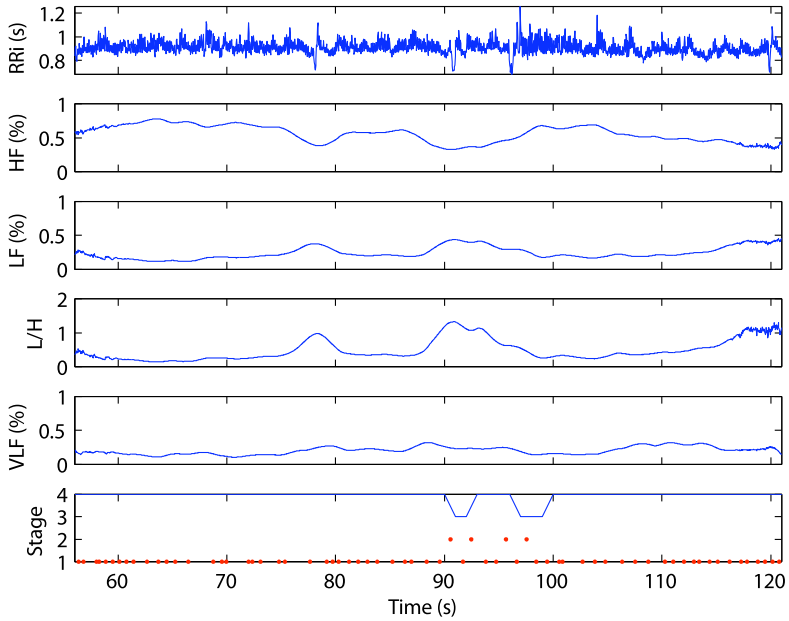
L/H
VLF (%)
Stage
Time (s)

Stable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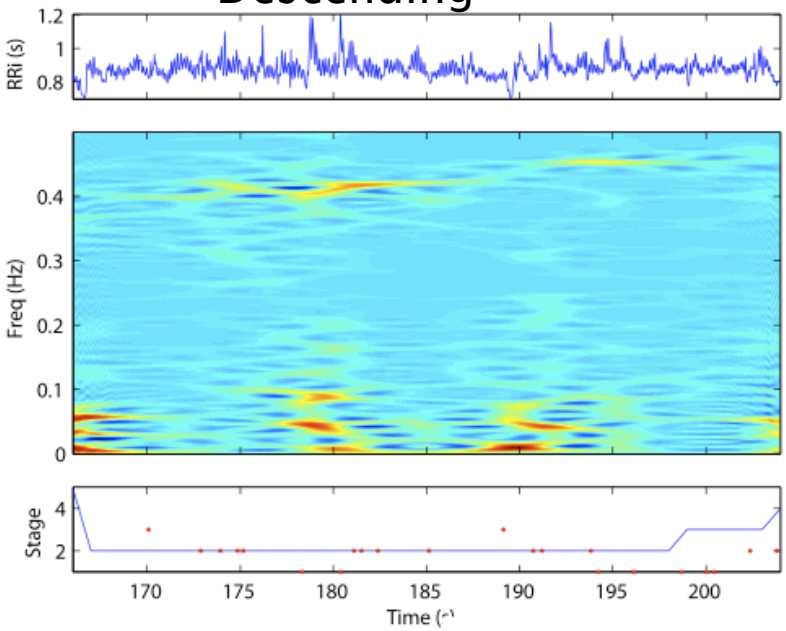
Stage
Time (s)

Descending



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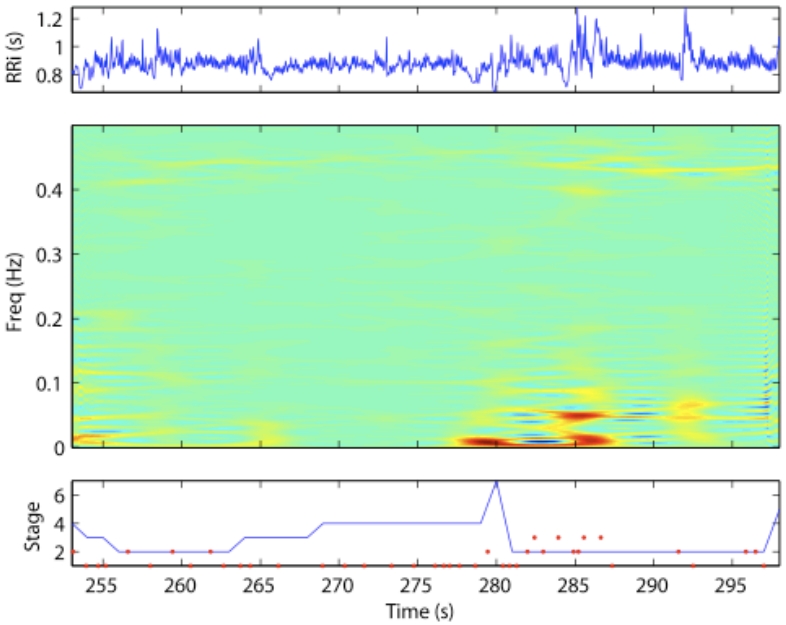

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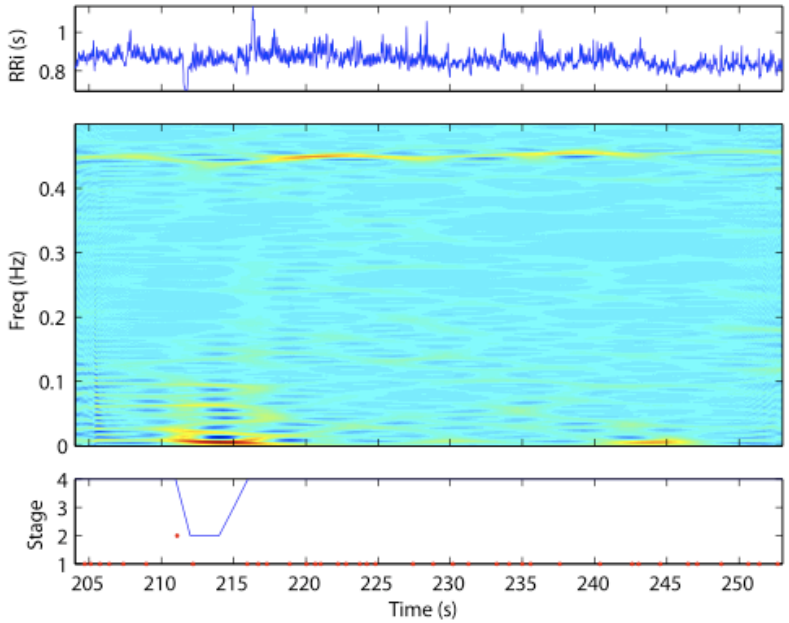

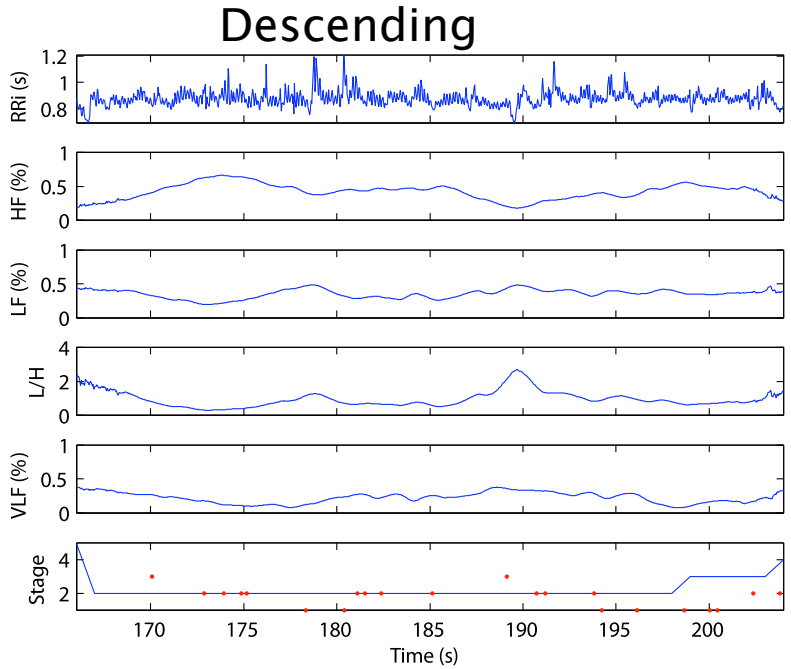
Descending
RRi (s)
HF (%)
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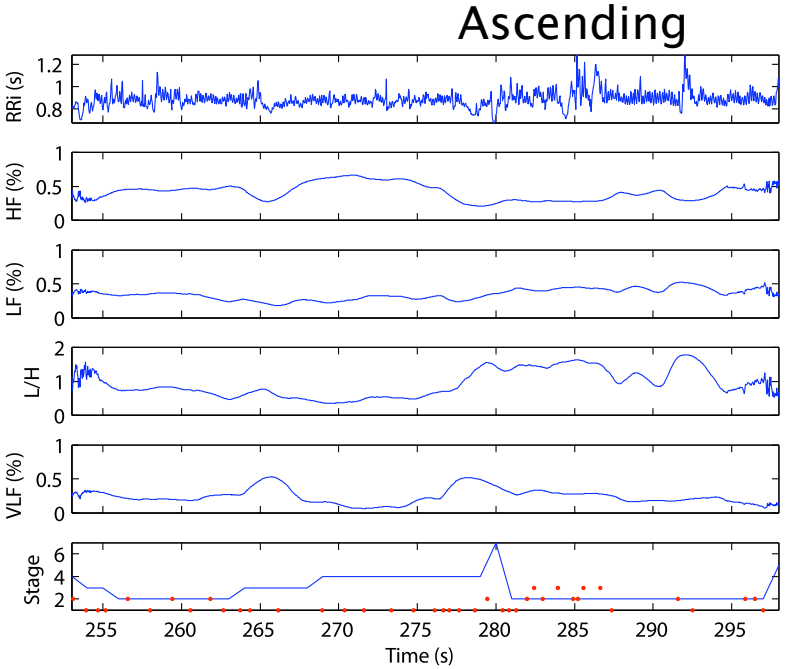
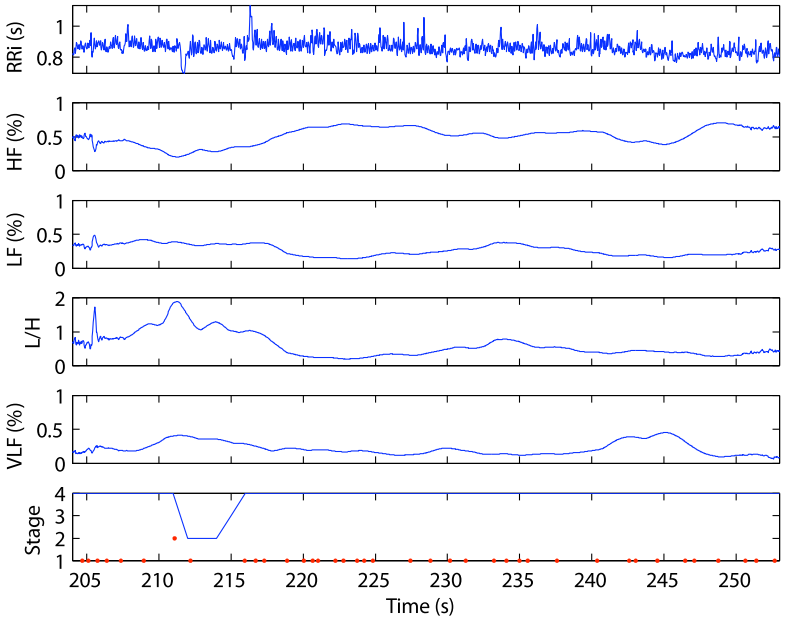
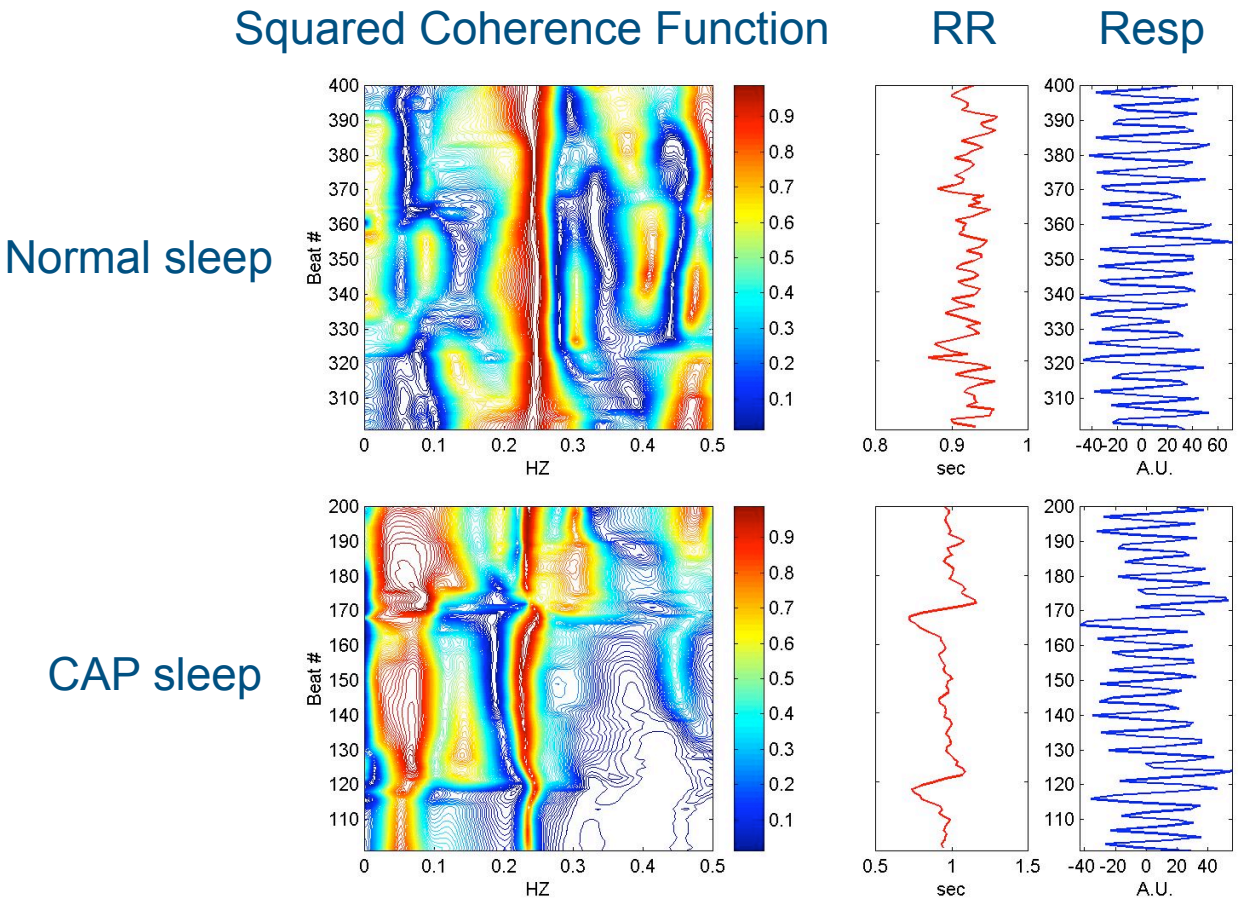
L/H
VLF (%)
Stage
Time (s)


Ascending
RRi (s)
HF (%)
LF (%)
L/H
VLF (%)
Stage
Time (s)

Stable

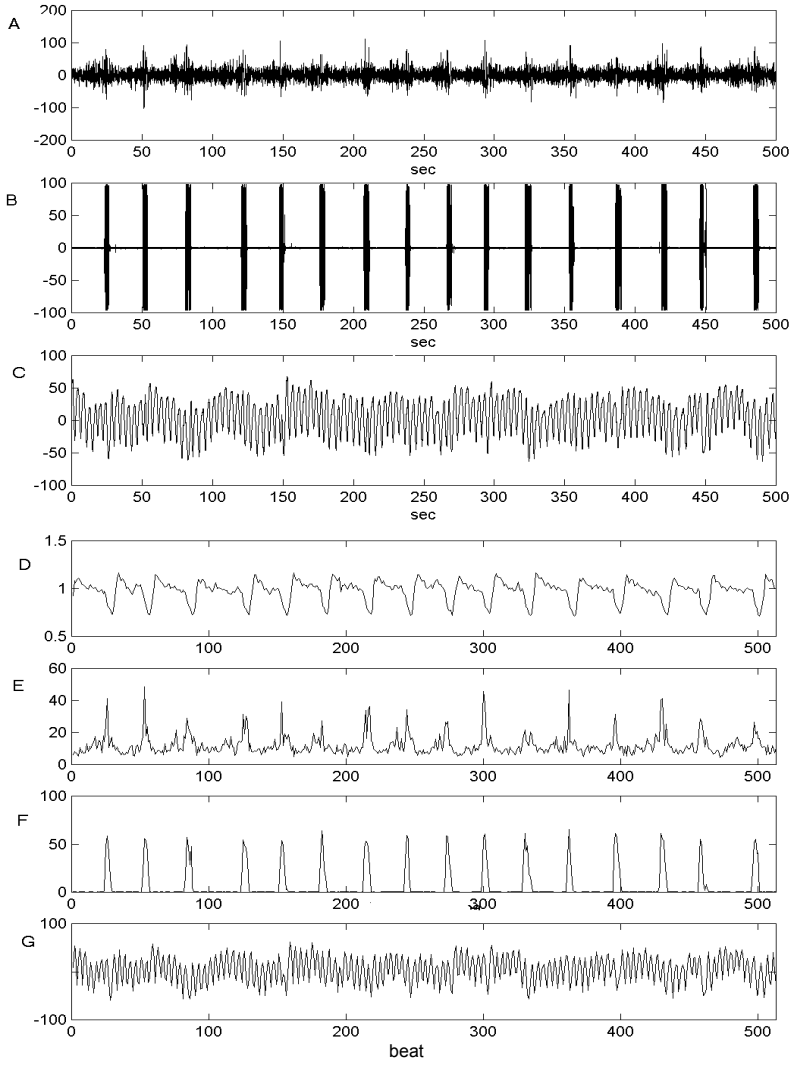

RRi (s)
HF (%)
LF (%)
L/H
VLF (%)
Stage
Time (s)

Cardio-Respiratory Coupling during CAP



Bianchi 2008 (submitted)

CAP and Periodic Leg Movement



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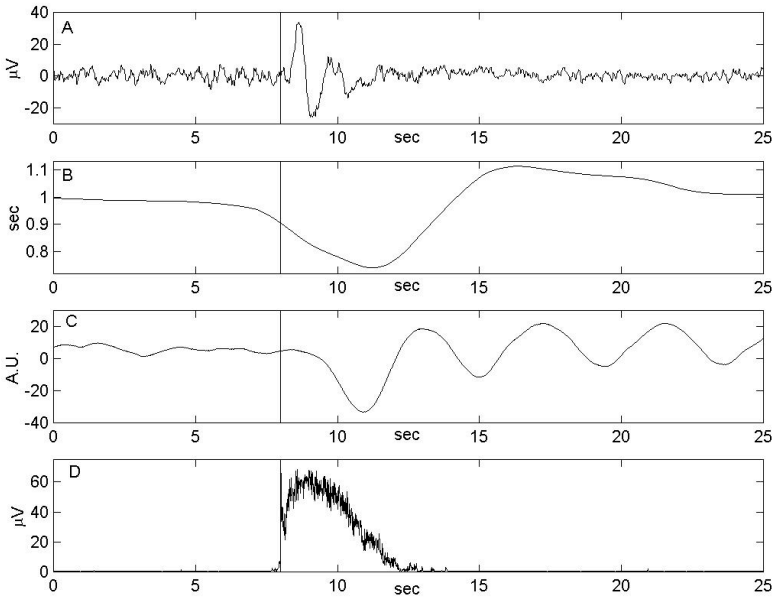
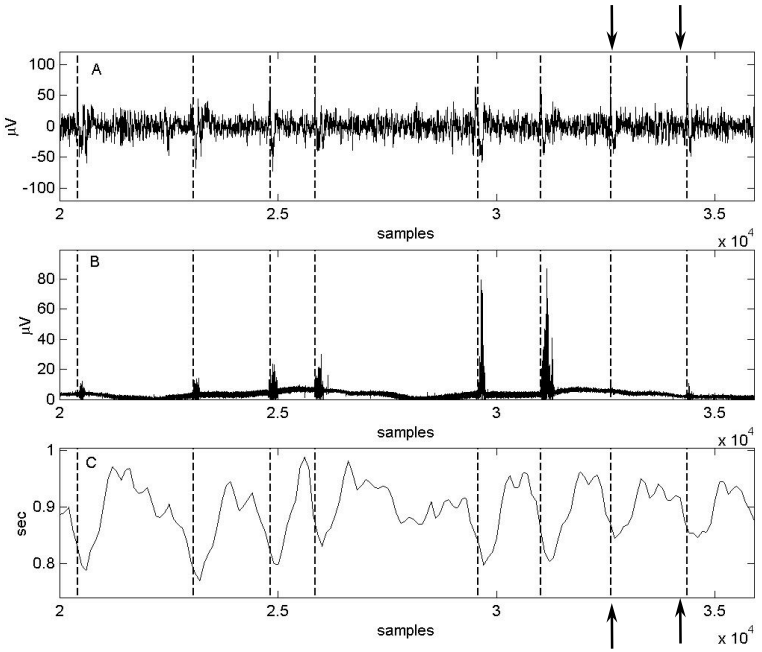
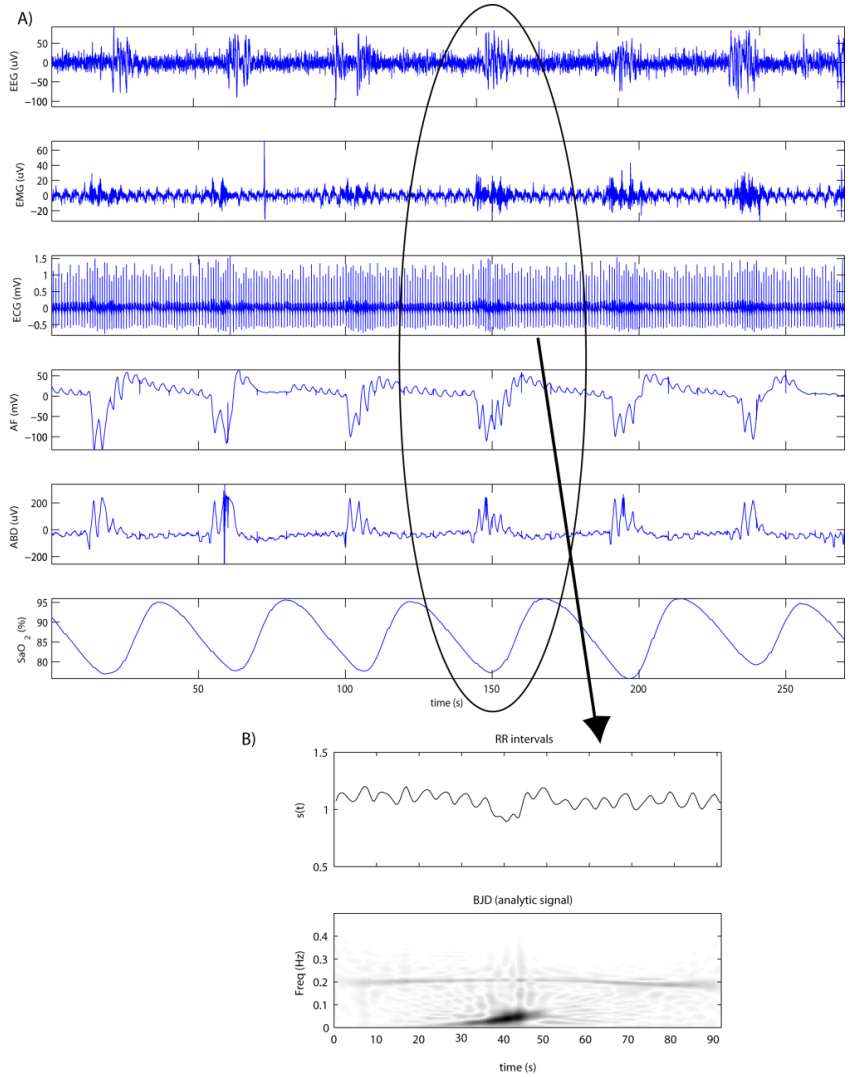
CAP and Periodic Leg Movement





Bianchi 2008 (submitted)

Sleep, CAP and Apnea



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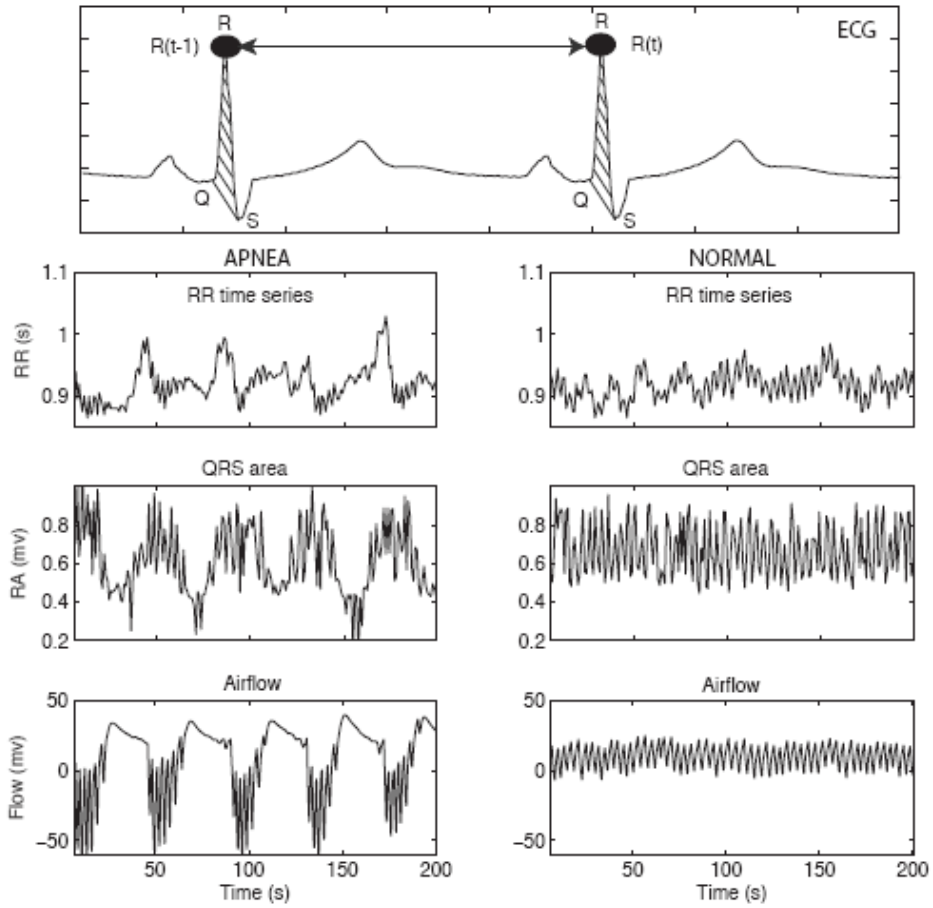
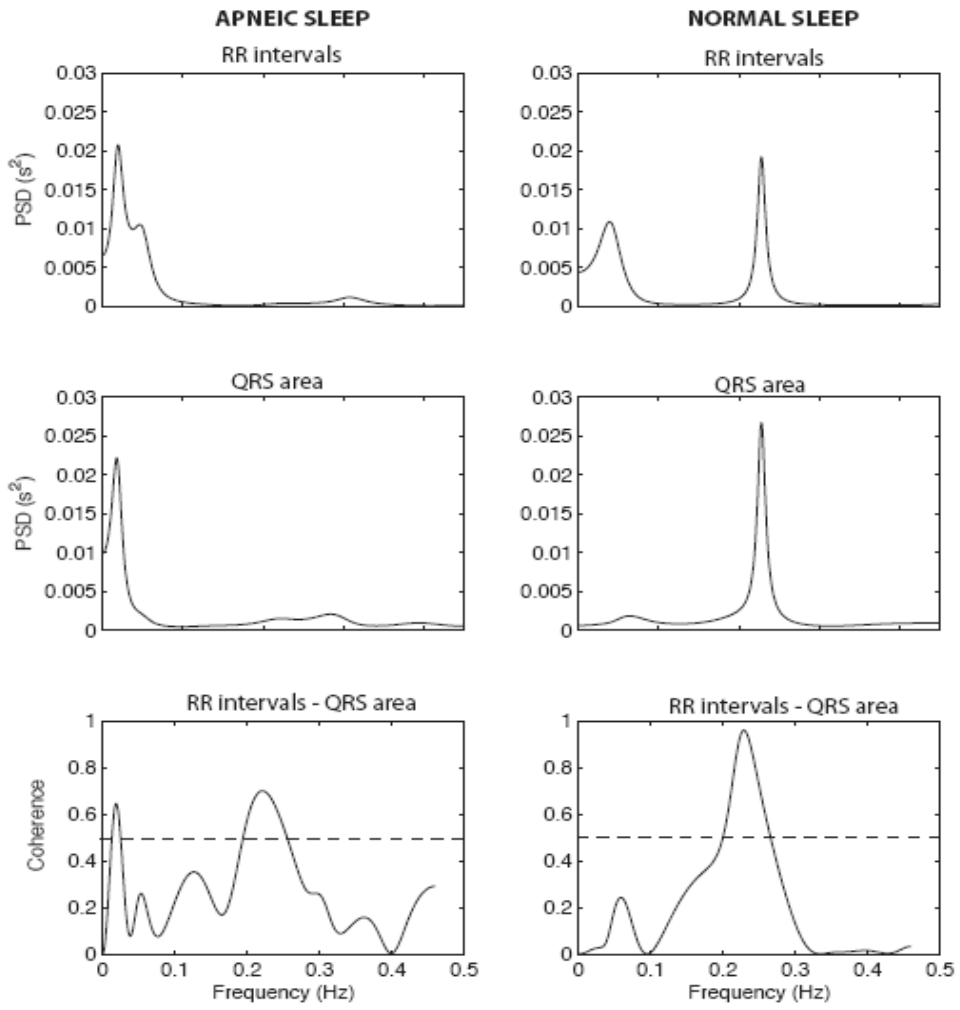
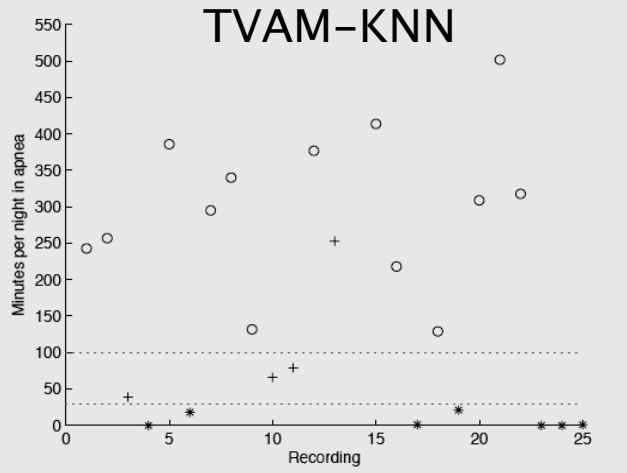
Cardio-Respiratory Coupling during Sleep Apnea

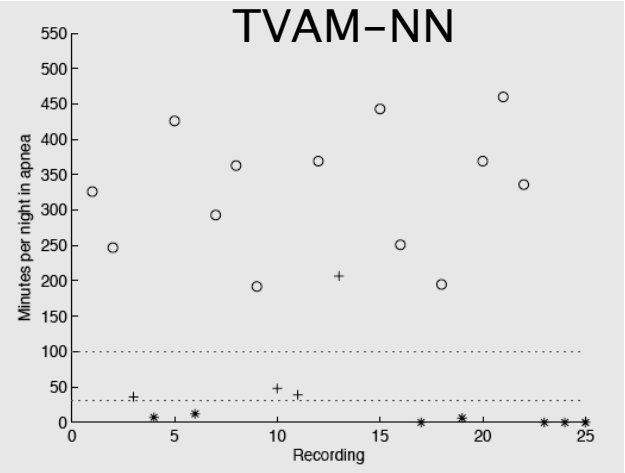


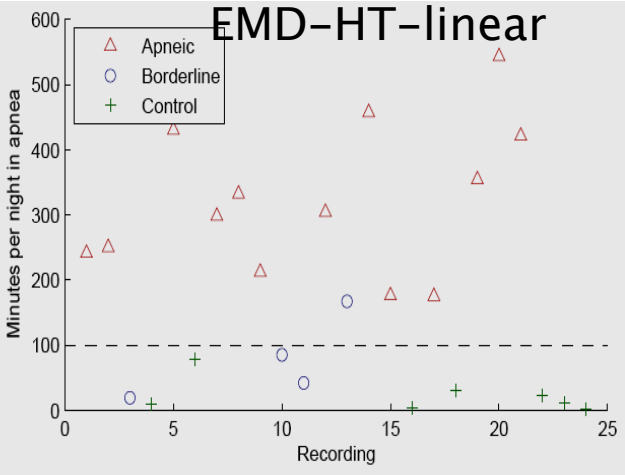
Cardio-Respiratory Coupling during Sleep Apnea

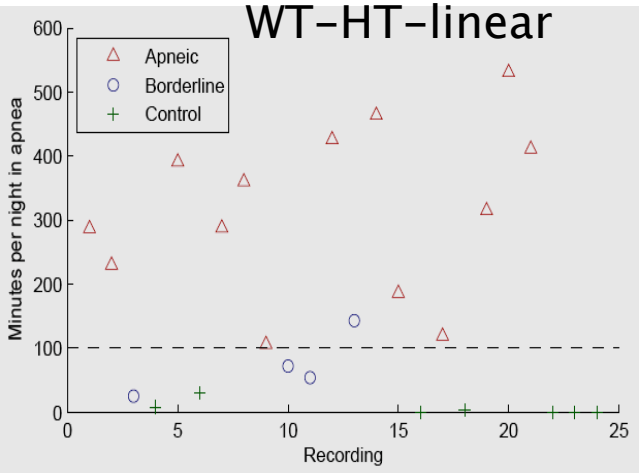


DSS in Sleep Apnea









Mendez 2008 (submitted)

Thanks

The best model of a cat
is another cat..., specially
the same cat.

Arturo Rosenblueth