VORに関与する神経核のNetwork motifs に基づいた機能分解についての仮説

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Data Description

- BRA Image
  - BIF image

    BIF image
  - HCD image

    HCD image
  - FRG image

    FRG image
- BRA Data

  NM24VestibuloOcularReflex.bra

Table 3: BRA DATA SUMMARY

BRA Data			
Object Name	Template	Including Content(s)	
		BIF	HCD/FRG
ProjectID.bra	*version 2.0*	√	√

Table 4: BRA IMAGE SUMMARY

Graphic Files: BIF Image, HCD Image, FRG Image	
File Type	Object Name
BIF Image	NM24VestibuloOcularReflexBIF.xml
HCD Image	NM24VestibuloOcularReflexHCD.xml
FRG Image	NM24VestibuloOcularReflexFRG.xml

Context

・Data for BRA of the vestibulo-ocular reflex (VOR), one of the key components of eye movements

・How to construct each BRA data

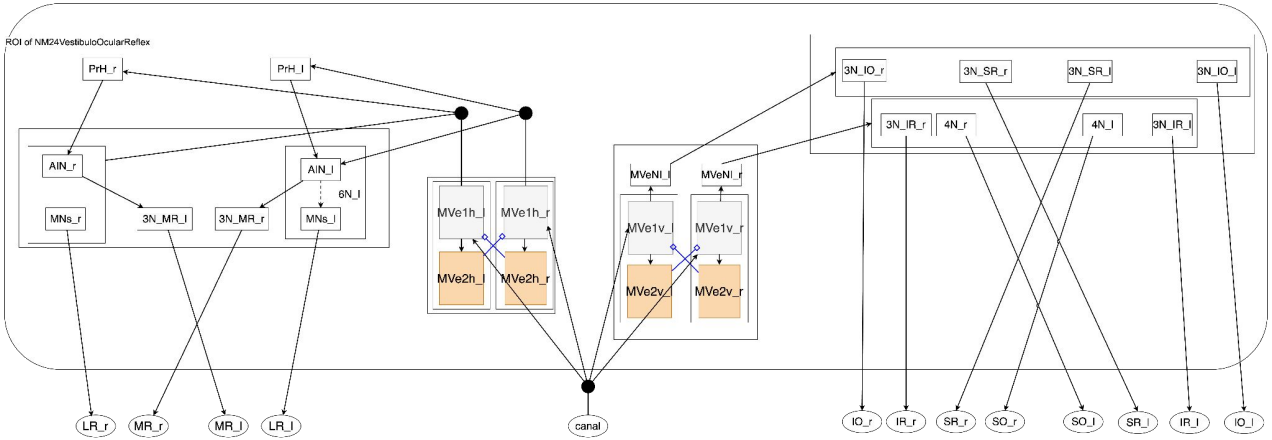
・Explanation of several hypotheses about new anatomical structures in some nuclei based on BIF/HCD/FRG

Data sheet and BRA image

- Circuit: 45
  (7 ROIs)

Abbreviations	Full Names
MVe	medial vestibular nucleus
PrH	prepositus hypoglossal nucleus
3N	oculomotor nucleus
4N	trochlear nucleus
6N	abducens nucleus
AIN	abducens internuclear neurons
MNs	motoneurons
LR	lateral rectus
MR	medial rectus
IO	inferior oblique
SO	superior oblique
SR	superior rectus
IR	inferior rectus

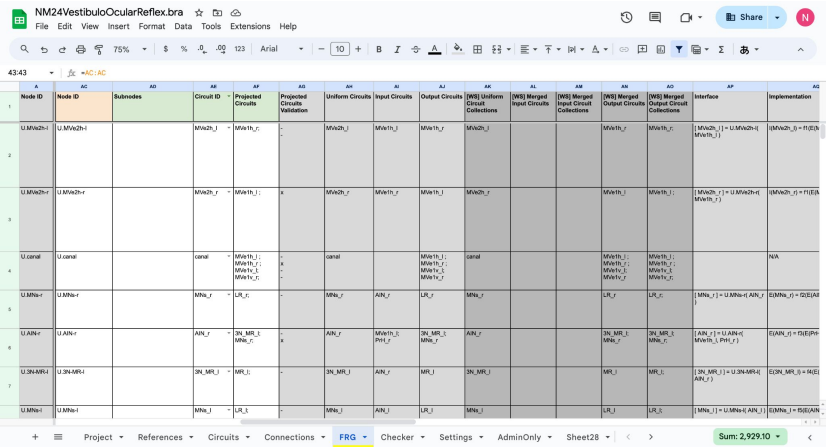
- Connections: 42

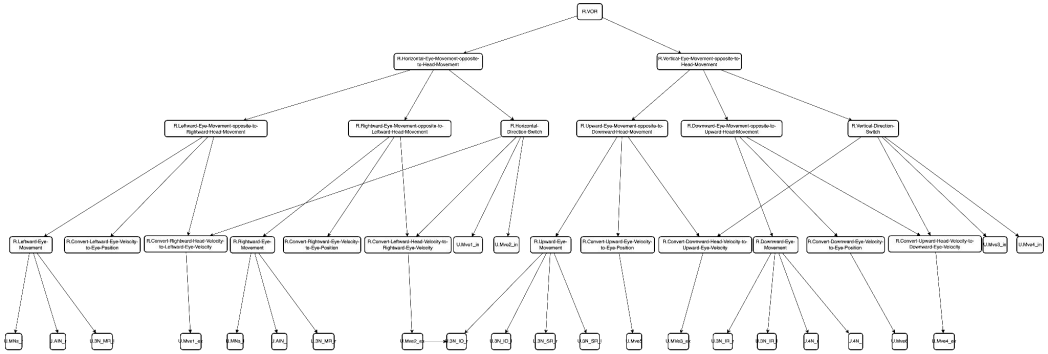


BIF image

Data sheet and BRA image

Node IDs of FRG: 42





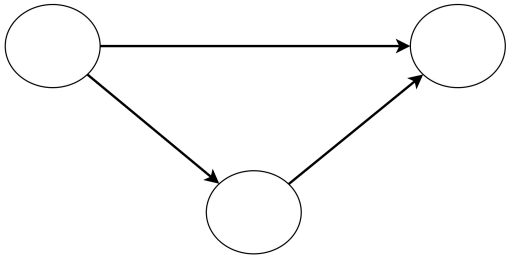
FRG image

Motifs

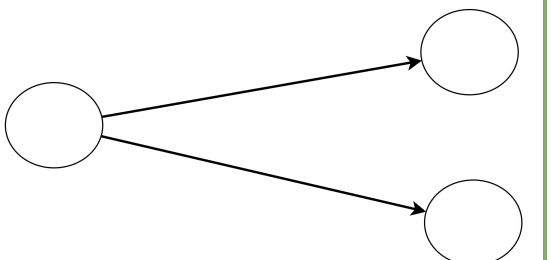
<u>”C” means the computational function</u>

A motif is a recurring circuit pattern composed of multiple nodes, which can be understood as a computational function that processes input-output transformations.

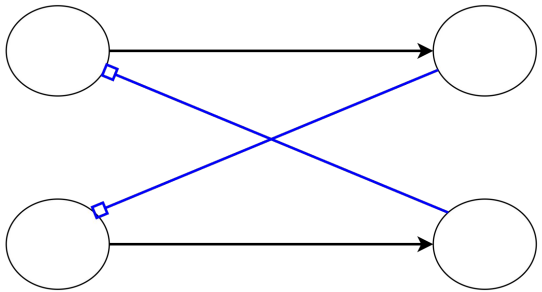
C.Integration



C.Divergence



C.Reciprocol Inhibition



How to construct FRG data

- Define **TLF** (top-level function)

  → **VOR**: To move the eyeballs in the direction opposite to head movement

- Hierarchical functional decomposition of TLF based on BIF

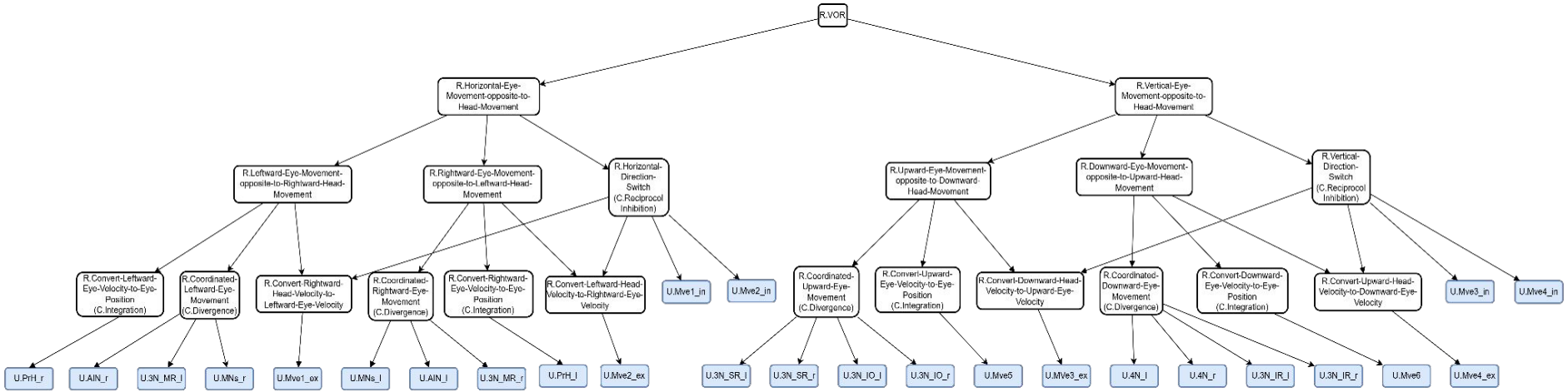
  → **Eye movement opposite to head movement + Direction Switching**

- Which are functionally decomposed into the following components

  (In the case of R.Leftward Eye Movement Opposite to Rightward Head Movement)

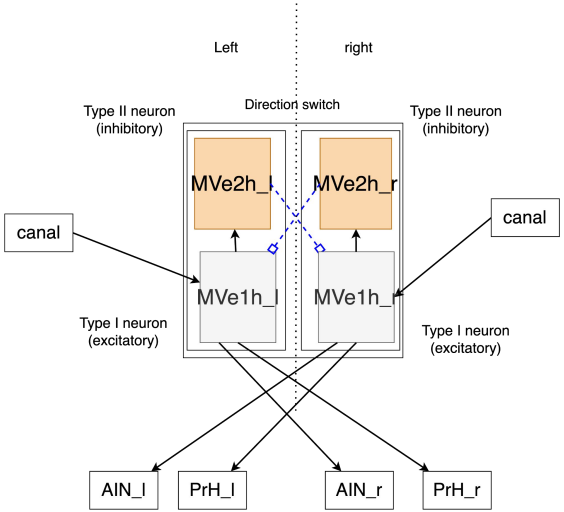
  - **R.Convert Rightward Head Velocity to Leftwad Eye velocity**
  - **R.Convert Leftward Eye Velocity to Eye Position**
  - **R.Leftward Eye Movement** (regulation of extraocular muscles)

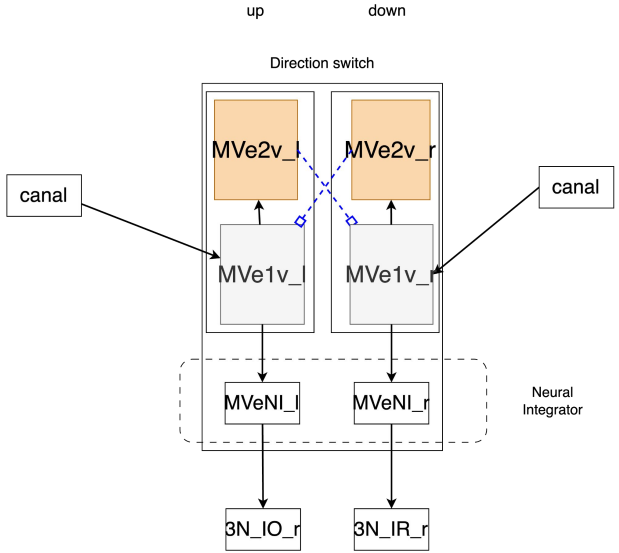
Constructed FRG



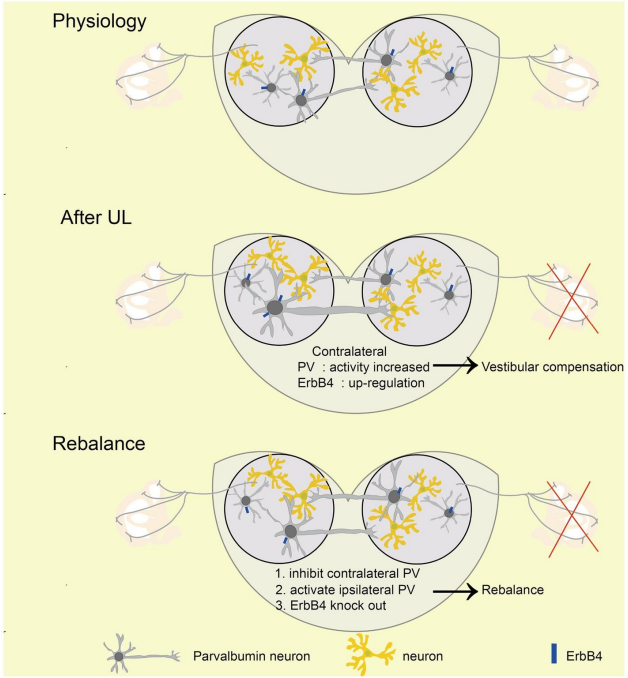
Proposed hypothesis

- Direction switching is accomplished by commissural inhibition in MVe
- In vertical VOR, MVe also plays a role as neural integrator





Commissural Inhibition in MVe

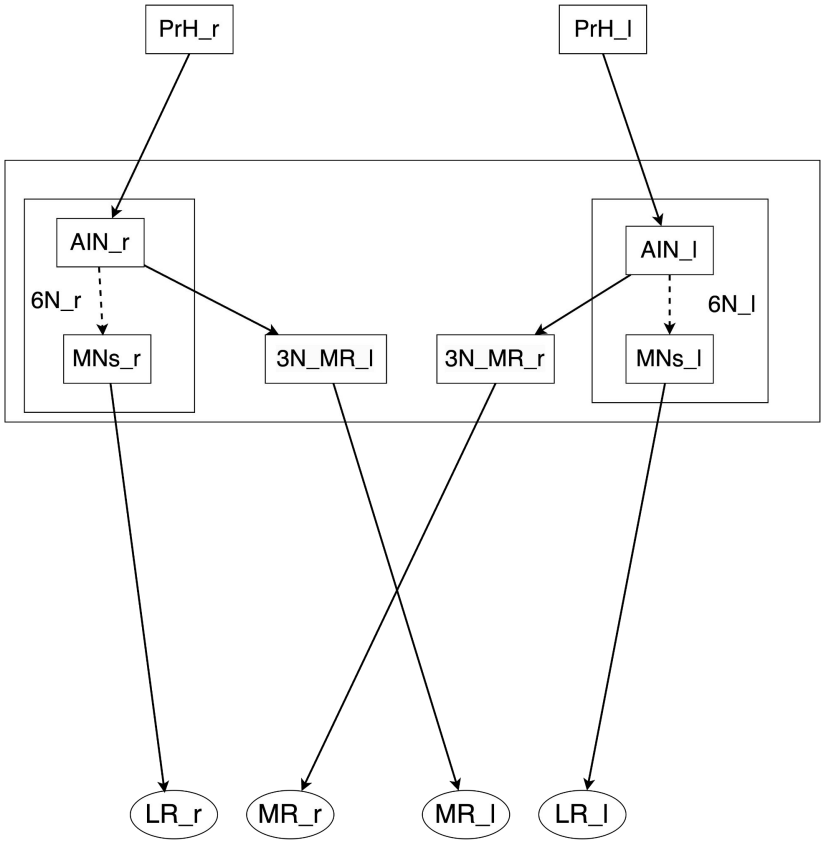


(Zhang et al., 2023)

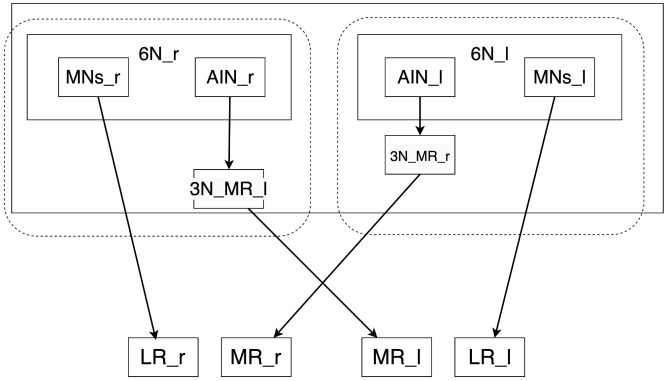
Proposed hypothesis

- 6N is divided into MNs and AINs
- Temporal discrepancy due to the differing number of processing steps
- The presence of a direct AIN-to-MNs connection

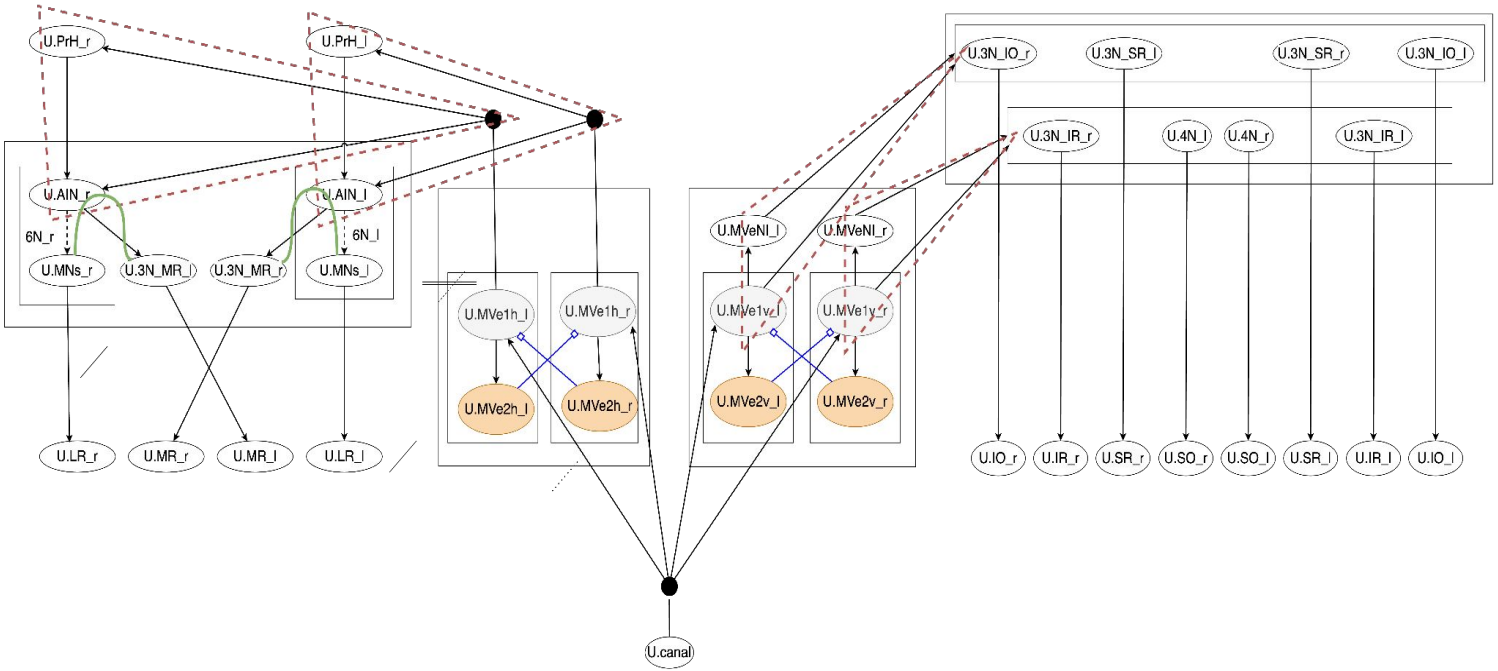
Hypothesized BIF:



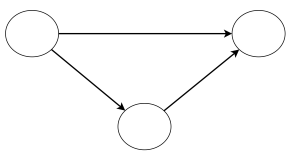
Conventional Model:



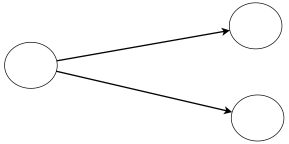
HCD with Motifs



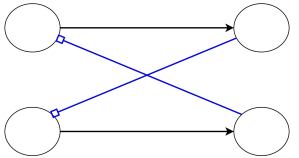
C.Integration



C.Divergence



C.Reciprocol Inhibition



Caveats for Data Usage / Future Publication

・This data includes several hypotheses for anatomical structures and functions relating to some nuclei such as MVe and 6N, thus requiring careful considerations when used.

・Poster Presentation at JNNS

「Hypothesized functional decomposition of nuclei involved in Vestibulo-Ocular Reflex based on Network motifs」