# Implementing curve detectors for contour integration

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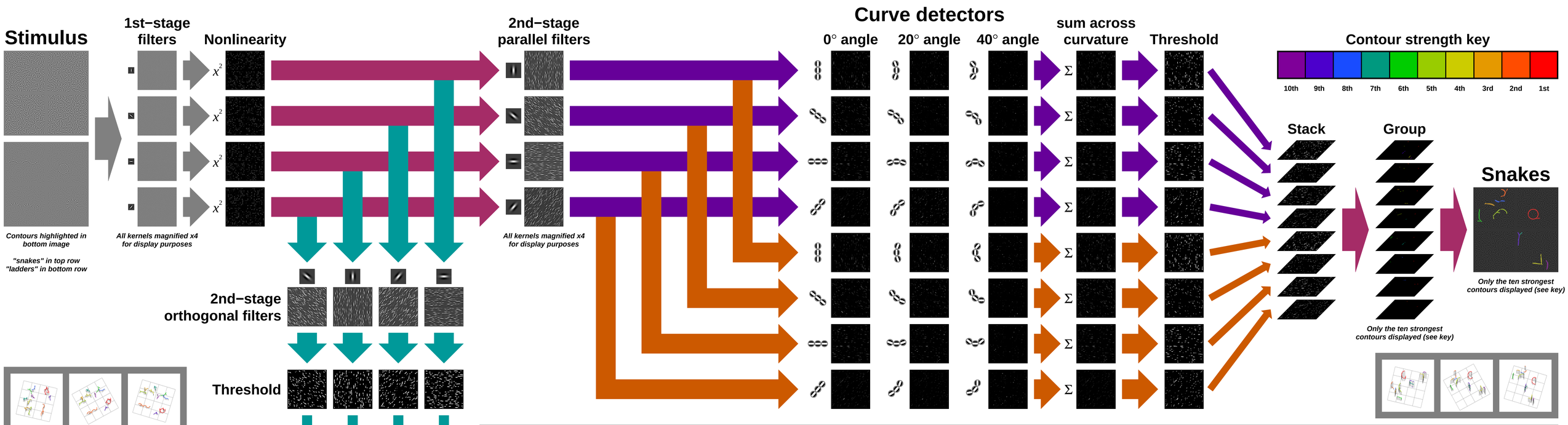



## Background

### Hess & Dakin's (1997) model

- Filter image with a range of oriented filters
- Threshold the output
- Within each orientation channel, group pixels that form spatially contiguous regions
- Lack of grouping across orientation channels prevents integration of smoothly curved contours, which change greatly in orientation from one end to the other

### May & Hess's (2008) model

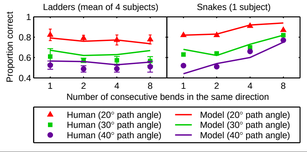
- Filter image with a range of oriented filters
- Threshold the output
- Group pixels that form contiguous regions across both space and orientation
- Grouping across orientation channels allows integration of smoothly curved contours

## 2nd−order filters

- May & Hess (2008) found that subjects could integrate widely spaced contours even when the elements had high−frequency carriers
- This rules out 1st−order filters because, to integrate widely spaced contours, you need large receptive fields, which don't respond well to high−frequency elements
- May & Hess (2008) proposed a 2nd−order mechanism:
  - Small−scale 1st−stage filters give strong positive and negative responses to the elements
  - Outputs of 1st stage are squared
  - Large−scale 2nd−stage filters can integrate across large inter−element distances
  - To detect snakes, each 2nd−stage filter must be parallel to the corresponding 1st−stage filter
  - To detect ladders, each 2nd−stage filter must be orthogonal to the corresponding 1st−stage filter
- May & Hess's (2008) model correctly predicts a weak effect of global shape on detection of ladders ...
- ... but can't explain why jagged snakes are harder to detect than smooth snakes (Pettet, 1999; Lovell, 2005)

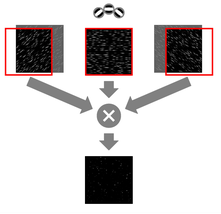
## Need for curve detectors

- Existence of curve detectors for snakes suggested by:
  - Effect of global shape on snake detection
  - Studies on adaptation to curved contours (Gheorghiu & Kingdom, 2007, 2009; Hancock & Peirce, 2008)
  - Existence of V4 cells selective for curved contours (Pasupathy & Connor, 1999)
- We varied the smoothness (number of consecutive bends in the same direction) of 9−element snakes and ladders
- Model fits data if curve detectors are applied to snake channels only




## Making curve detectors

- We followed Gheorghiu & Kingdom's (2009) proposal that the curve detectors multiply the outputs of sub−units along the contour
- Implemented by point−by−point multiplication of spatially shifted outputs from different orientation channels (after half−wave rectification)



## References

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## Acknowledgements

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