

# OPEN QUESTIONS

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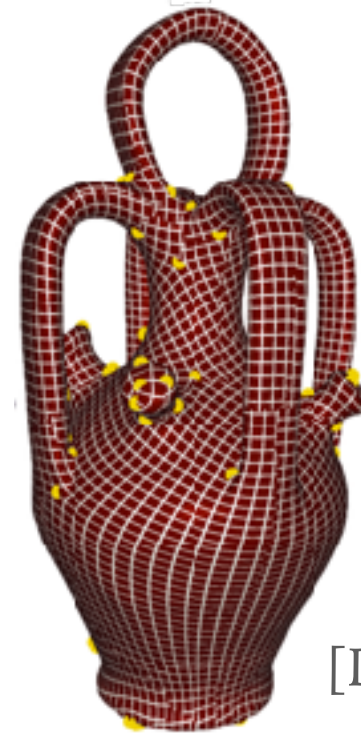
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# OPEN QUESTIONS: TOPOLOGY CONTROL

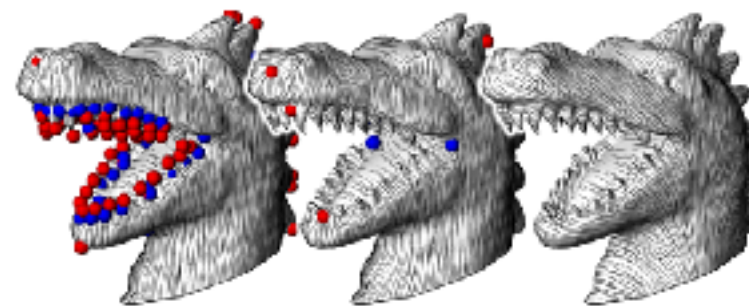
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- Implicit Methods
  - Unpredictable singularities
    - Usually many low-degree.



[Diamanti *et al.* 2015]

- Explicit Methods
  - Specifying singularities
  - Direction fields
  - ...but nonconvex



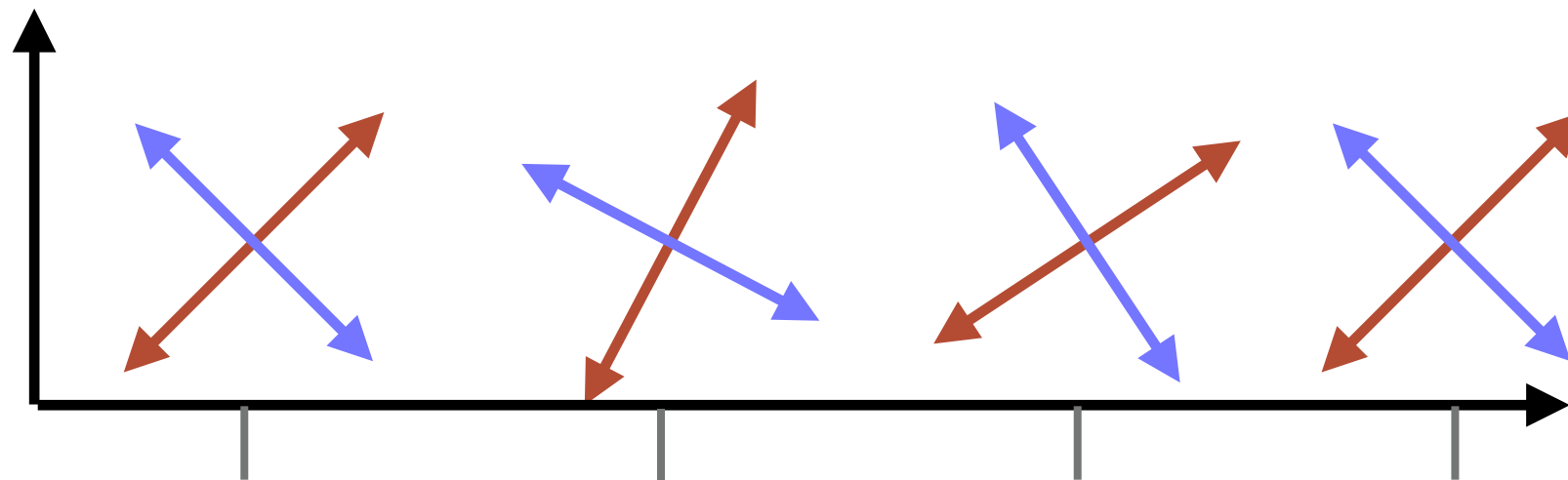
[Ray *et al.* 2009]

- **Current attempts:** alternatives to as-parallel-as-possible.

# OPEN QUESTIONS: SAMPLING & CONVERGENCE

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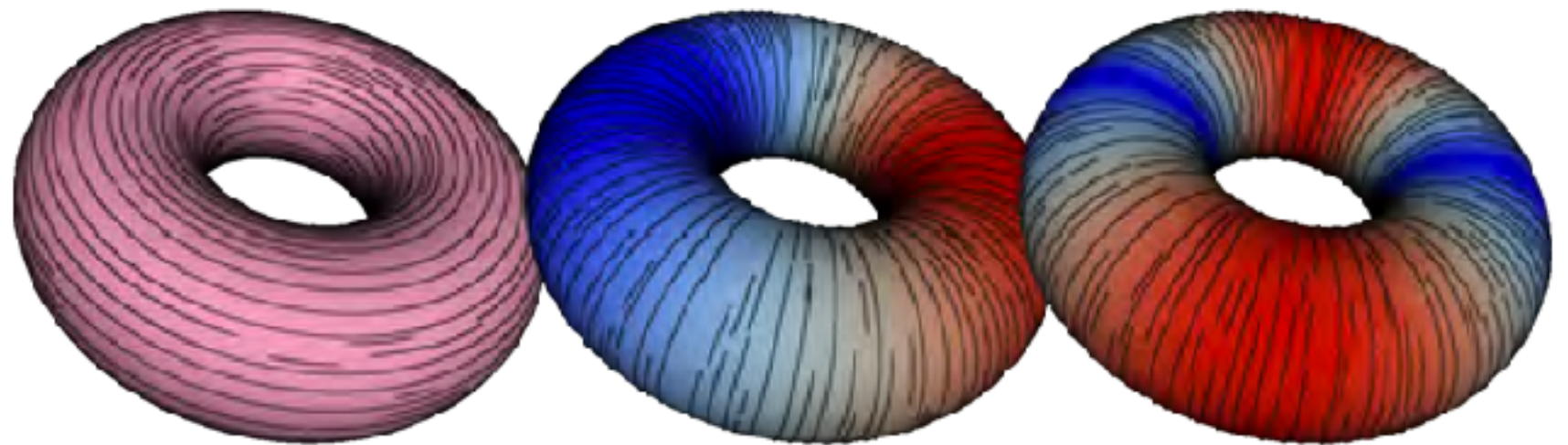
- **Discrete animals:** matching, period jumps.
- Bridge the gap between the continuous and the discrete.
  - **Current attempts:** subdivision.
- What is a good sampling?



# OPEN QUESTIONS: GEOMETRY

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- Lie Bracket
  - [Azencot *et al.* 2013, de Goes *et al.* 2014, Azencot *et al.* 15].
  - Local and directly on vector fields
- Differential geometry of directional fields
  - Calculus
  - Operators

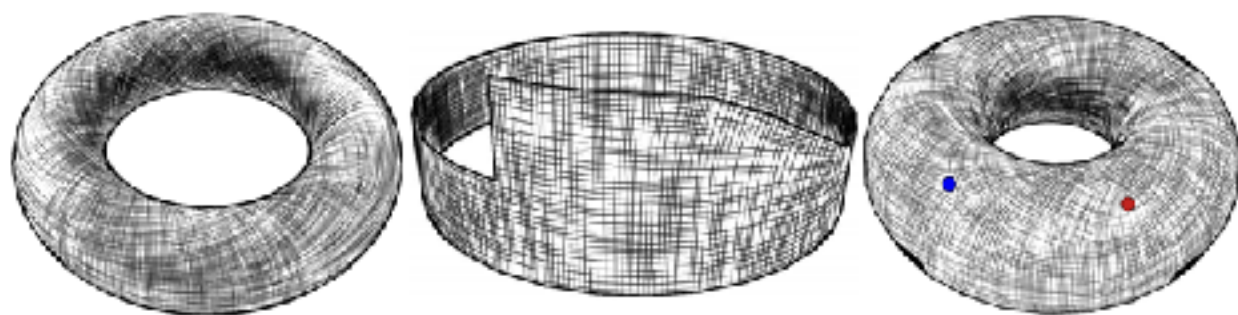


[de Goes *et al.* 2014]

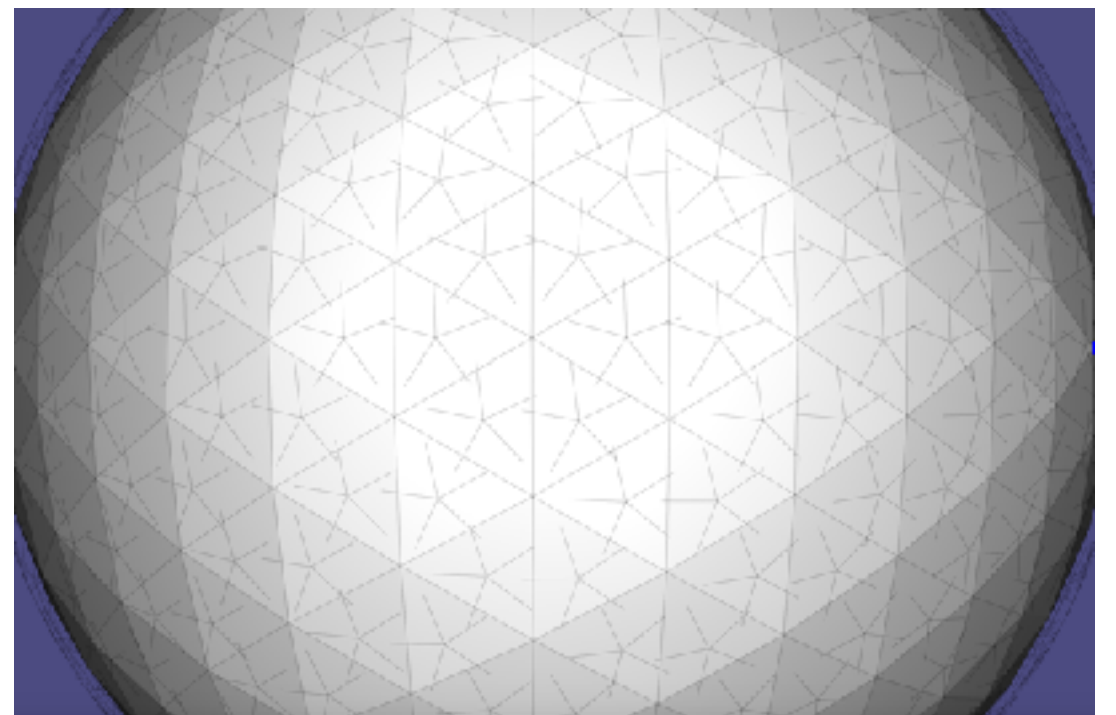
# OPEN QUESTIONS: PARAMETRIZATION

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- Branched functions are more restricted than directionals.
- **Param  $\rightarrow$  vectors**: always possible.
- **Vectors  $\rightarrow$  Params**: *generally* impossible.
  - [Kälberer *et al.* 2007, Izmestiev *et al.* 2012, Myles *et al.* 2014]
- What is the space of parametrizing directionals?



[Myles *et al.* 2014]

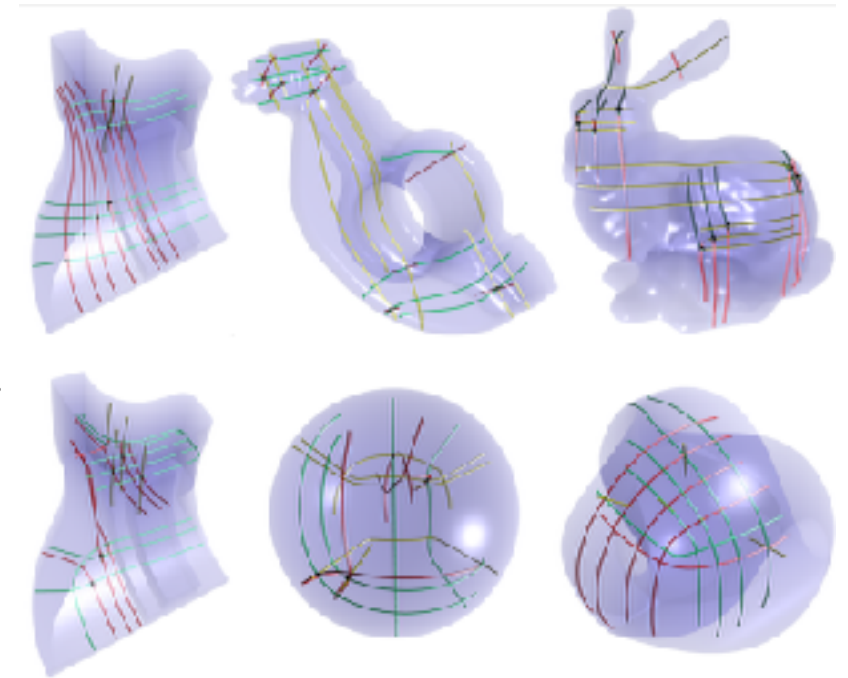




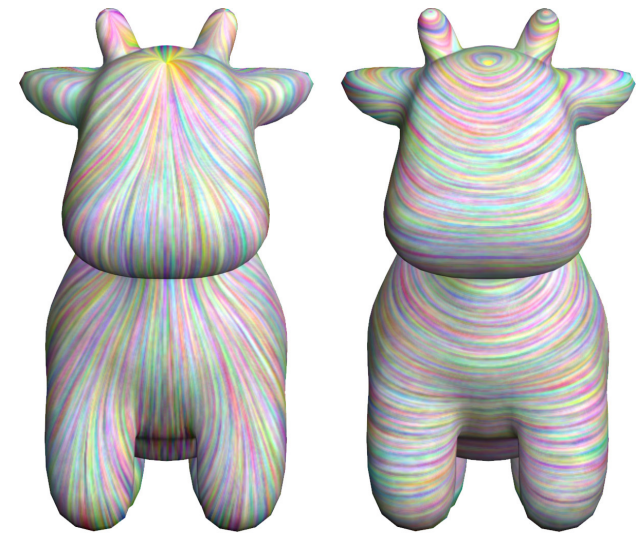
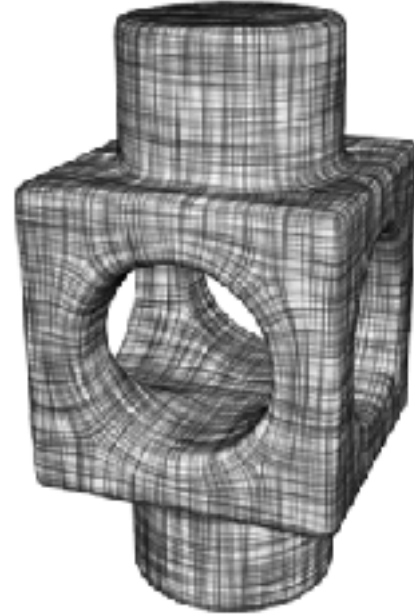
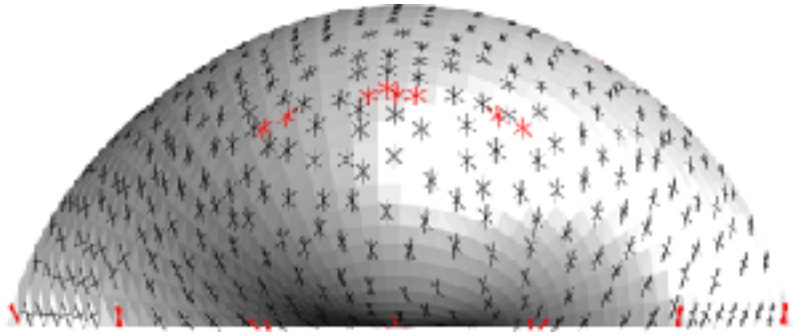
# OPEN QUESTIONS: THREE DIMENSIONS

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- Generalization is difficult:
  - Rotations are not commutative.
  - No notion of angle-based representation.
- **Singularities:** curves and nodes.
  - Index theorem?
- **Current attempts:**
  - Quaternions [Kowalski *et al.* 2014, Panozzo *et al.* 2017]
  - Tensors [Paris *et al.* 08]
  - Spherical Harmonics [Huang *et al.* 2011, Ray *et al.* 2016, Solomon *et al.* 2017]



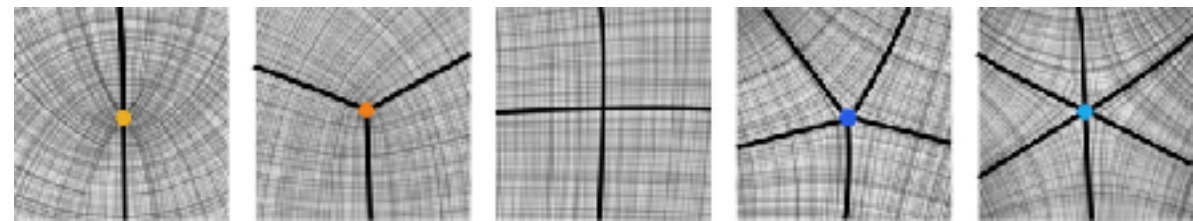
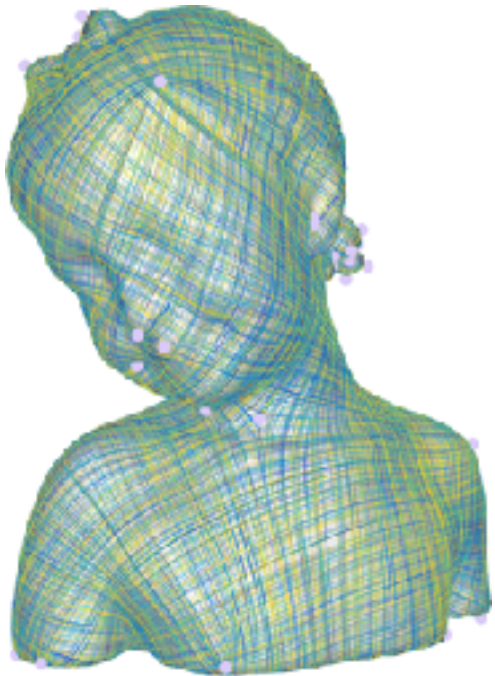
[Huang *et al.* 2011]



Symmetry

Anti-symmetry

# THANK YOU!



\*Course repository: <https://github.com/avaxman/DirectionalFieldSynthesis>