Optimal control of Polar Active Fluid

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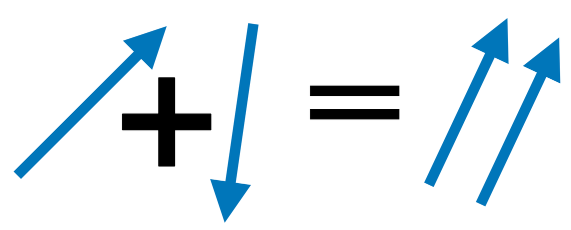
Model

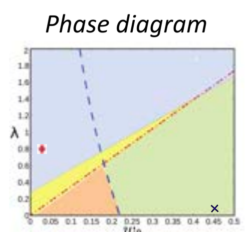


$\rho(\mathbf{r})$ – Density
$\vec{P}(\mathbf{r})$ – Polarization
$\vec{\tau} = \rho\vec{P}$

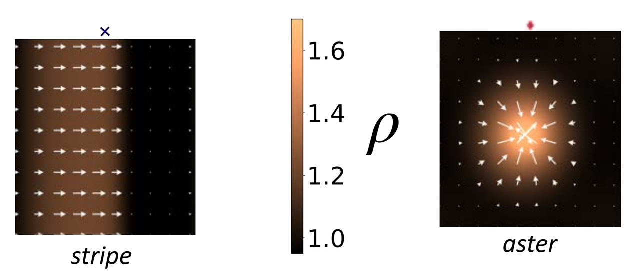
$$\partial_t \rho = -\nabla\cdot(\omega\vec{\tau} - \nabla\rho).$$

$$\partial_t\vec{\tau} = -(a_2(\rho) + a_4(\rho)|\tau|^2)\vec{\tau} - \nabla(\omega\rho) + \nabla^2\vec{\tau} + \lambda\left(\tau_\alpha\nabla\tau_\alpha + \vec{\tau}\nabla.\vec{\tau} - \vec{\tau}.\nabla\vec{\tau}\right).$$

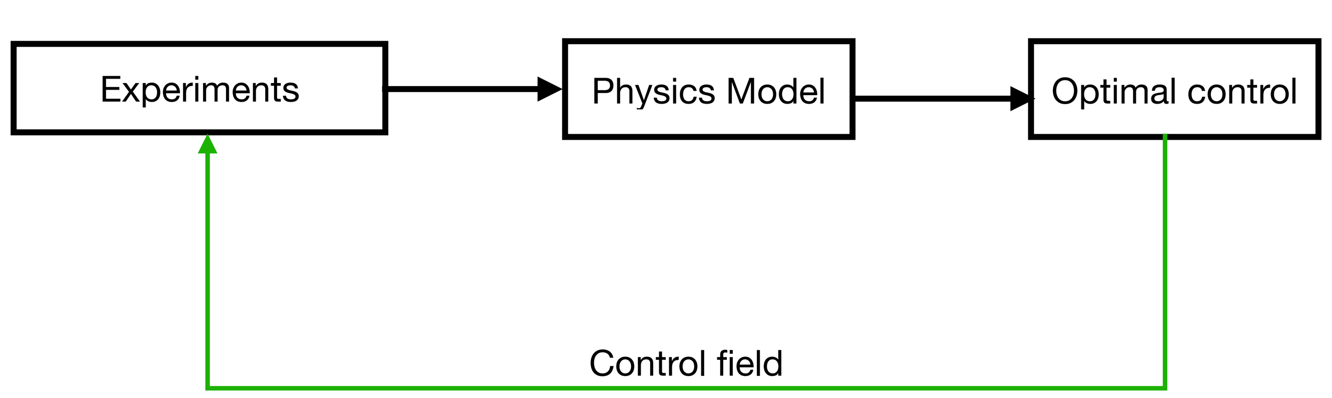
ω–activity

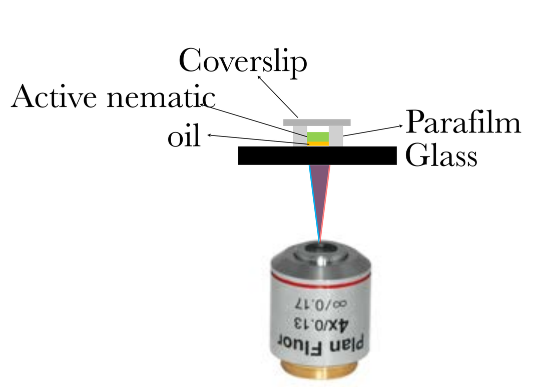


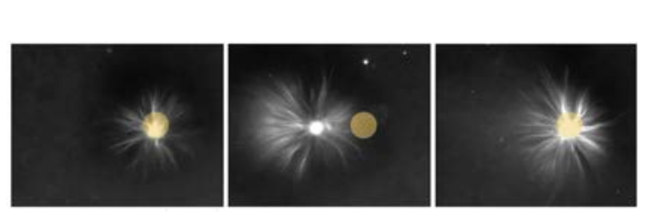
λ–interaction



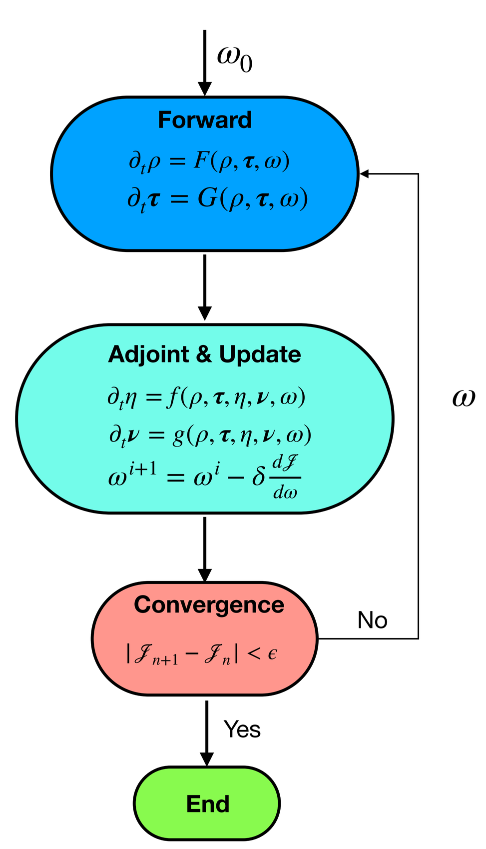
Optimal control



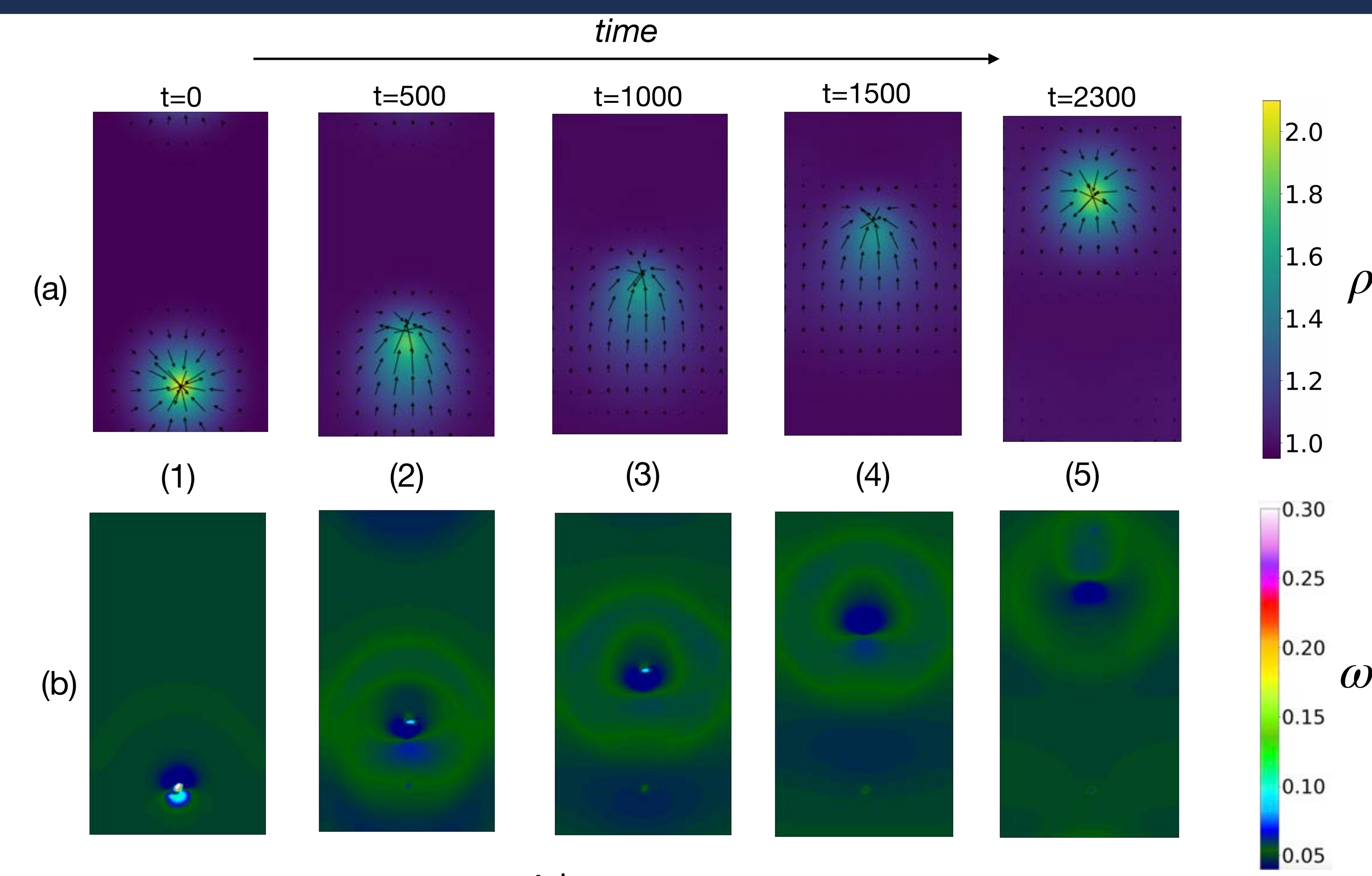




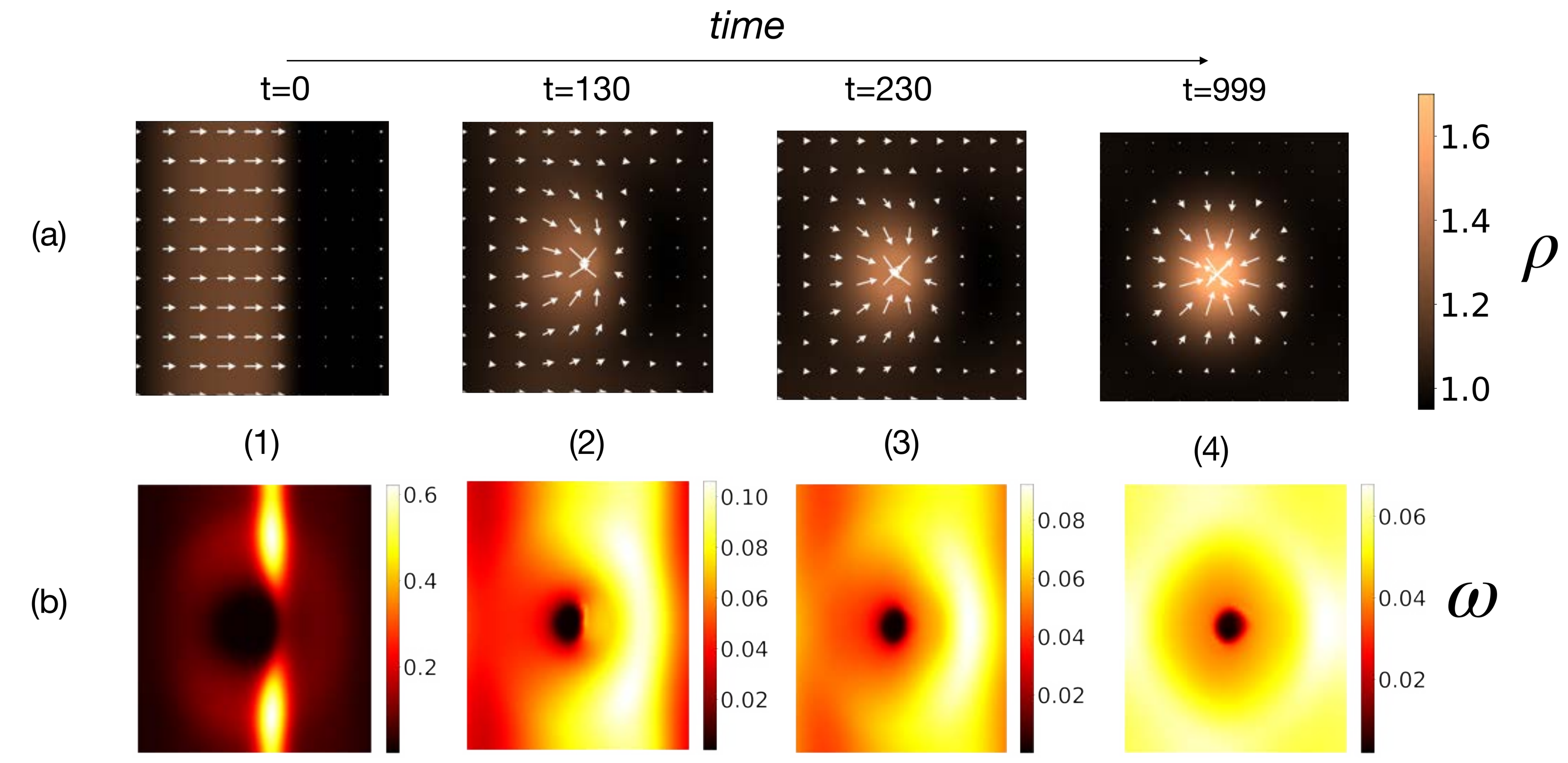
Experiment



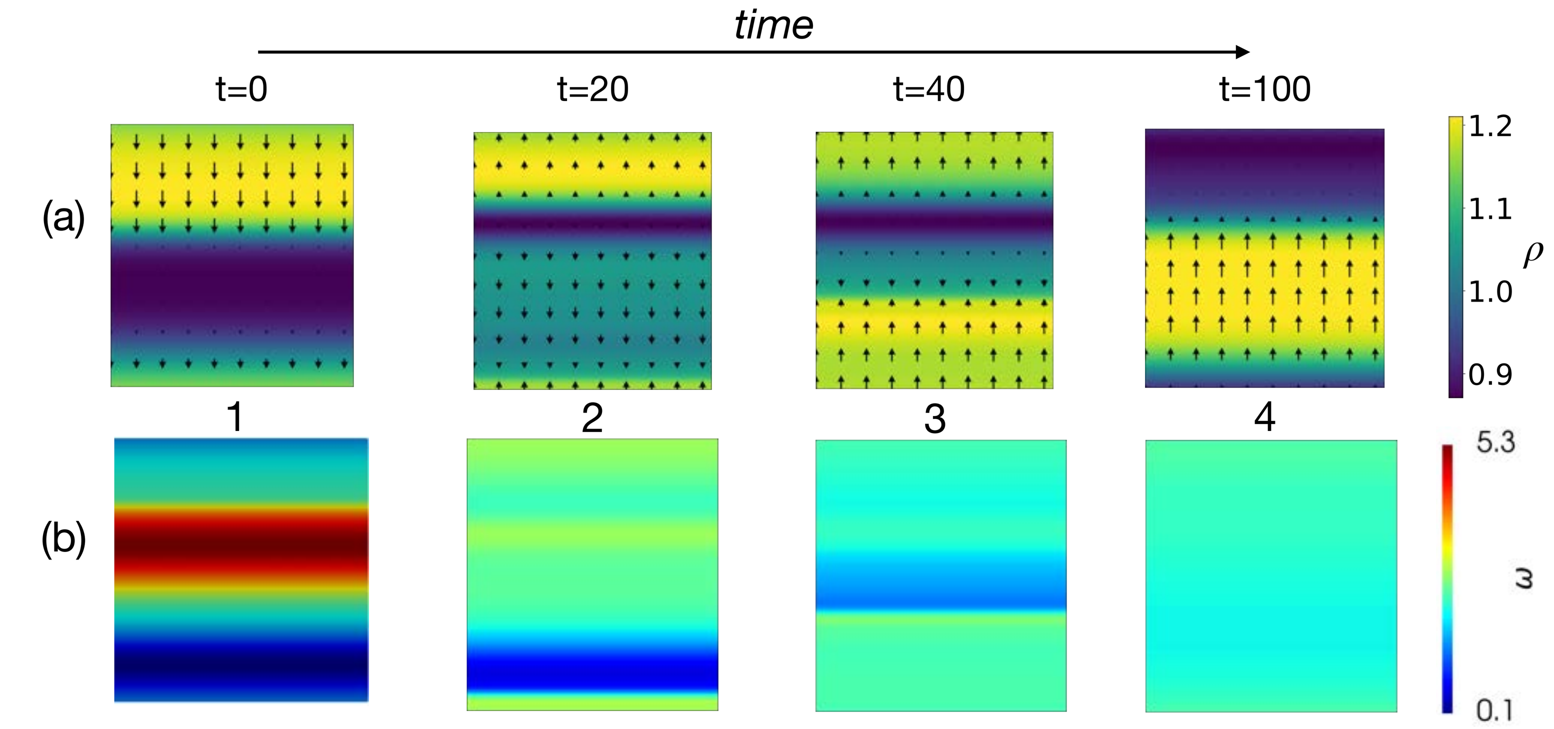
Results



Advect an aster

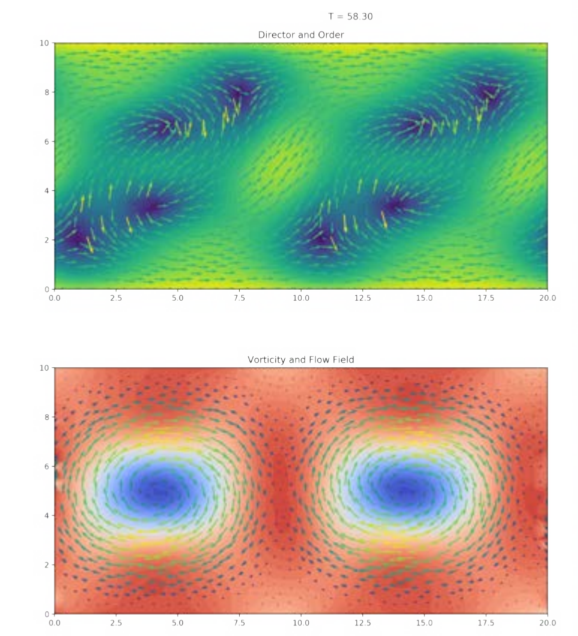


Remodel an aster to stripe

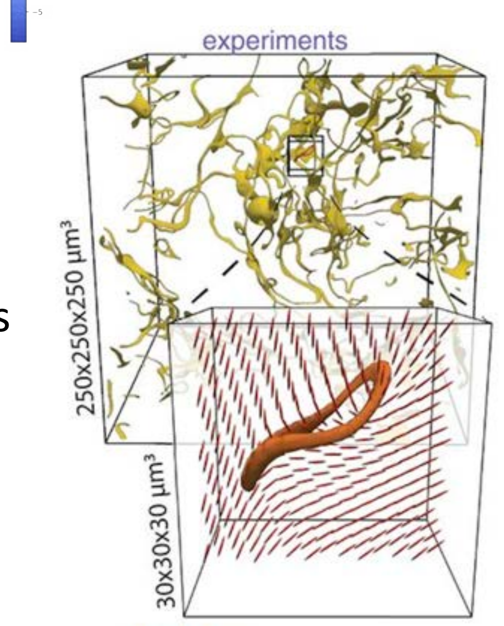


Reorient a moving stripe

Future Directions



2D active nematics



3D active nematics

References

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