Streamlining in fire ant rafts

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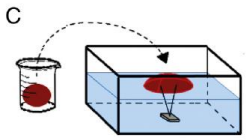
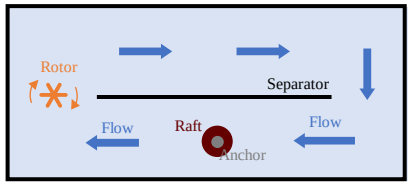
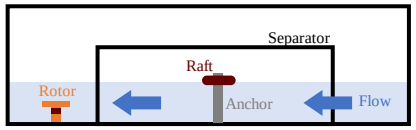
EXPERIMENTAL OBSERVATION

ANT BALLS EXPAND TO MAKE RAFTS

- Fire ant aggregation expands from a 3D ball to 2D raft when put on water
- The expansion has very short time scale around 200 s for 3,000-ant raft







RAFTS DEFORM UNDER FLOW

- Small raft with 250 ants under flow rate 6 cm/s
- Rafts shrink to ball shape with and without flow
- During deformation, raft either adopts elliptical or airfoil shape

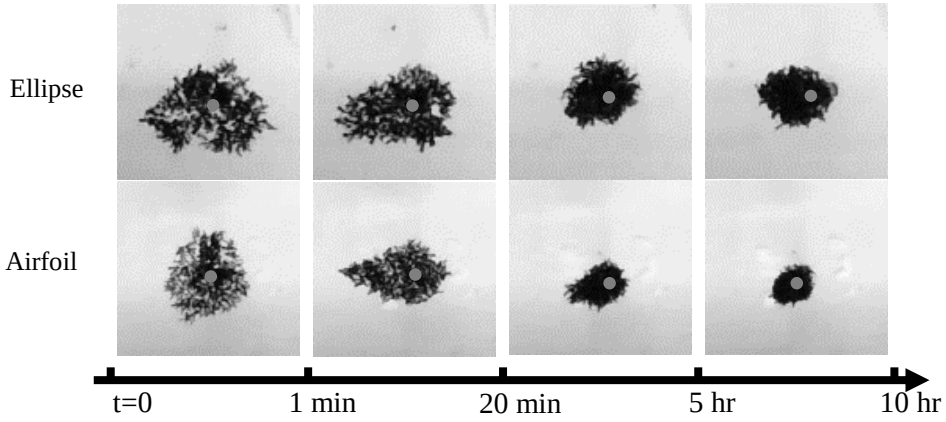
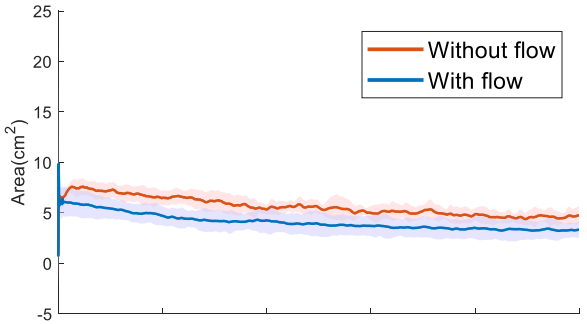
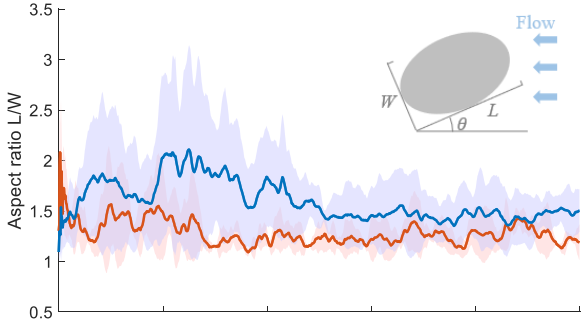


IMAGE ANALASIS

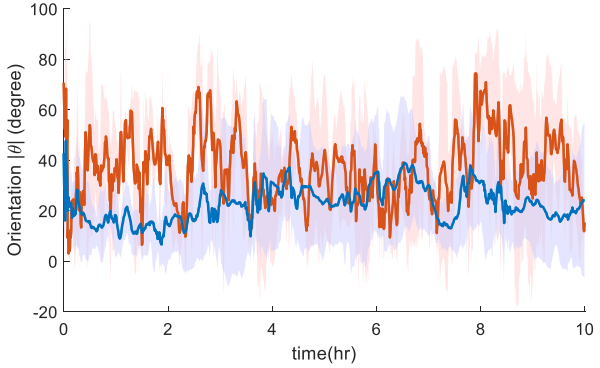
RAFTS SHRINK EARLIER UNDER FLOW



RAFTS STRETCH UNDER FLOW



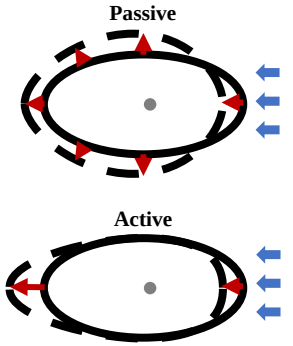
RAFTS ALIGN WITH FLOW

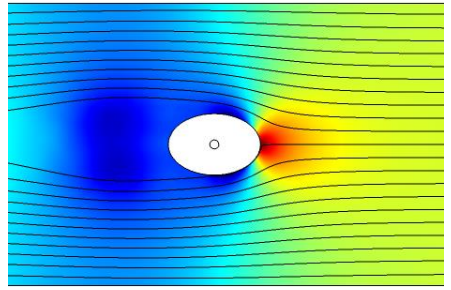


SIMULATION

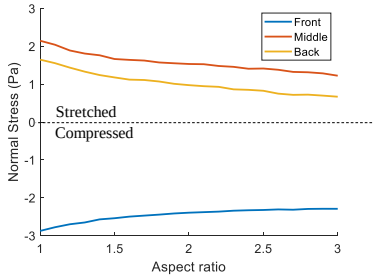
PASSIVE RAFT WOULD DEFORM DIFFERENTLY

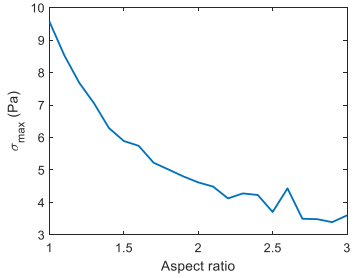
- If the raft was passive, it would be stretched in the transverse direction due to lower pressure





FLUID & SOLID STRESS DECREASE WITH ASPECT RATIO





CONCLUSION

- fire ant rafts deform into either elliptical or airfoil shape under flow, with aspect ratio 2, before contracting into a dense ball
- passive raft would become wider in middle section
- elongation decreases fluid stress at raft boundary and solid stress on raft