LAB MEETING 1

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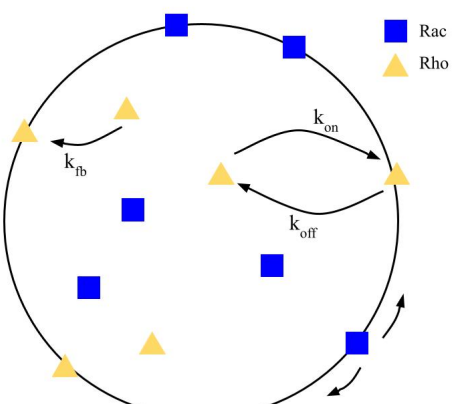
Single Cell

- Rac and Rho particles inside the cell and on the cell membrane
- Bind to the membrane with rate k_{on}
- Unbind from the membrane with rate k_{off}
- Recruit particles with rate k_{fb}
- Particles can also diffuse along the membrane



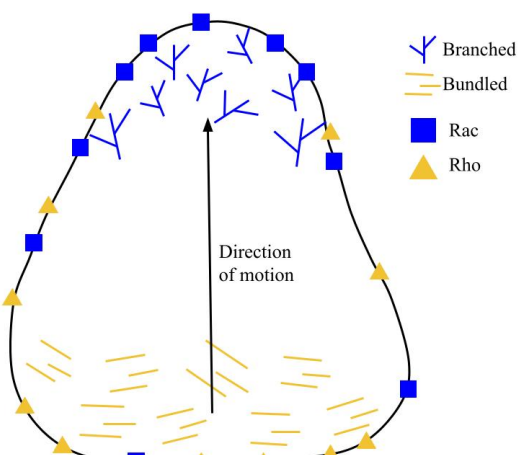
SINGLE CELL

- Branched and bundled actin networks
- Rac forms branched networks with actin
- Rho forms bundled networks with actin
- Branched actin is protrusive and bundled actin is contractile

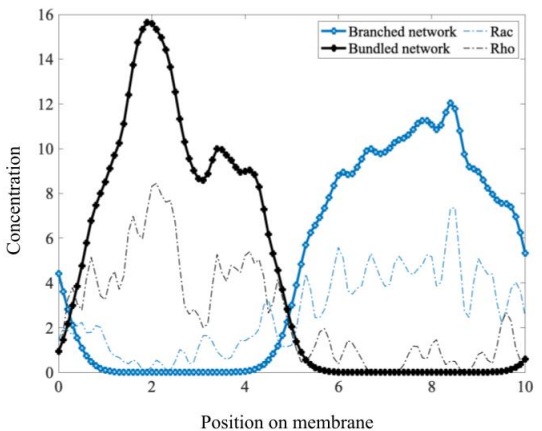
Equations for branched actin (a)
and bundled actin (b):

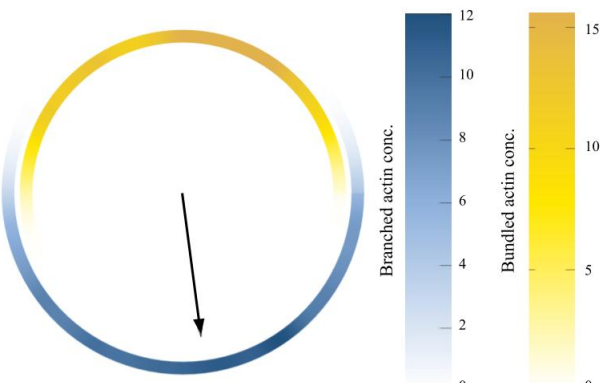
$$\frac{\partial a(s,t)}{\partial t} = K_a(a(1+\alpha n_{rac}(s,t))-a^2)-m_0 ab+D_a\Delta a$$

$$\frac{\partial b(s,t)}{\partial t} = K_b(b(1+\alpha n_{rho}(s,t))-b^2)-m_0 ab+D_b\Delta b$$



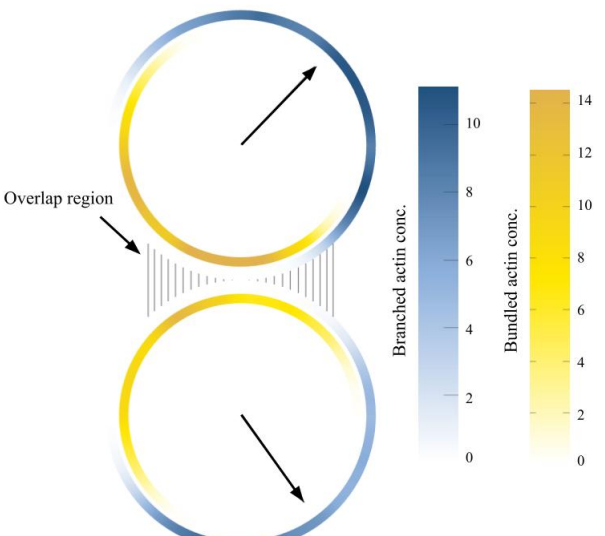
SINGLE CELL


Branched network
Bundled network
Rac
Rho
Concentration
Position on membrane
0
2
4
6
8
10
12
14
16


Branched actin conc.
Bundled actin conc.
0
2
4
6
8
10
12
0
5
10
15

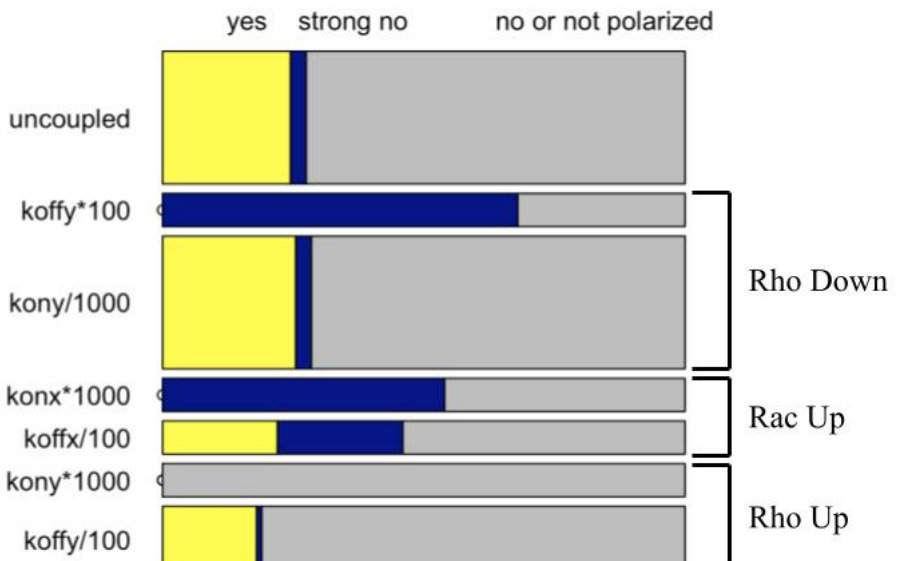
Two Cells

- Define a contact region between the two cells
- Uncoupled: nothing different happens at the contact region
- Determine if the cells are going in the same direction; within 45 degrees = yes



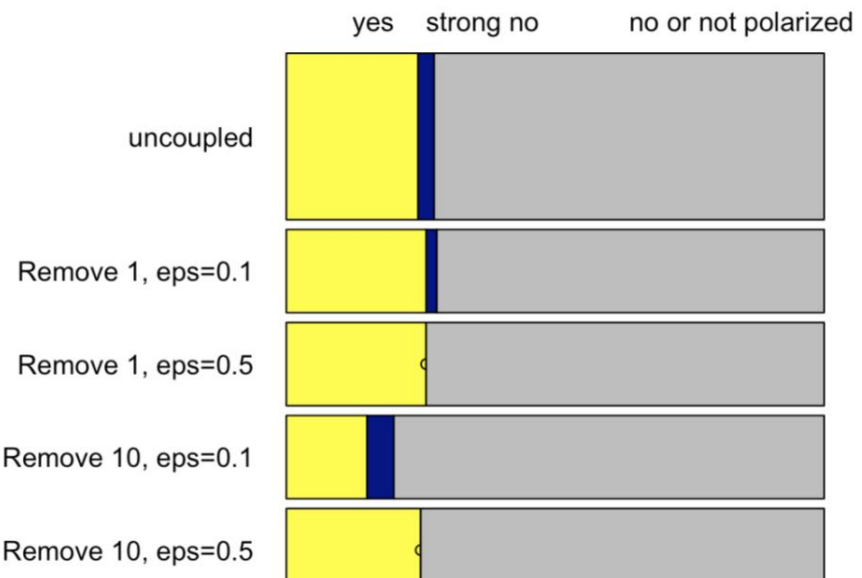
Rac/Rho Binding and Unbinding

Change binding rate (k_{on}) or unbinding rate (k_{off}) for rac (x) or rho (y) in the contact region.



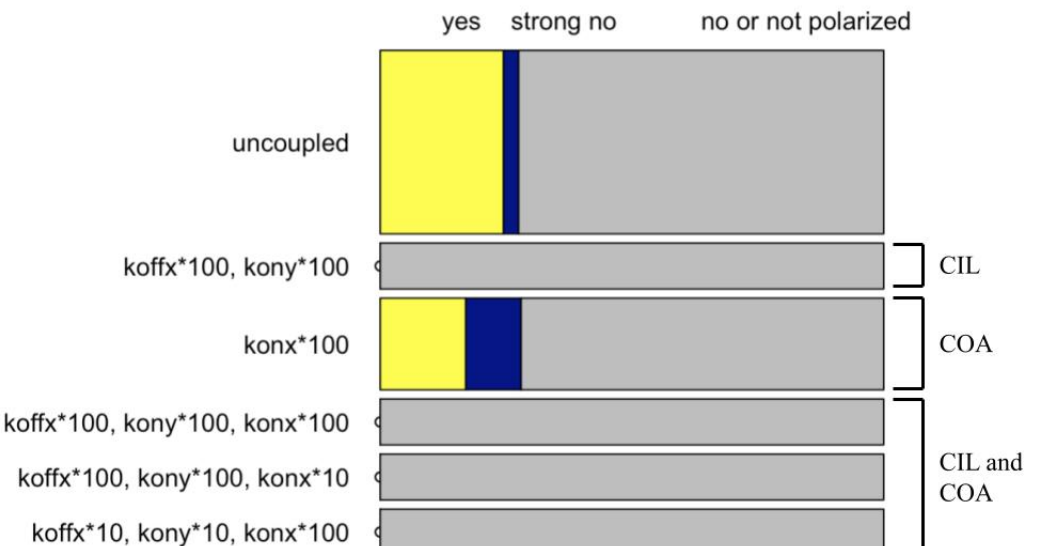
Increased Antagonism Between Rac and Rho

When a rac particle binds in the overlap region in cell 1, remove 1 or more nearby ($\varepsilon = 0.1, 0.5$) rho particles in cell 1. Do the same for cell 2.



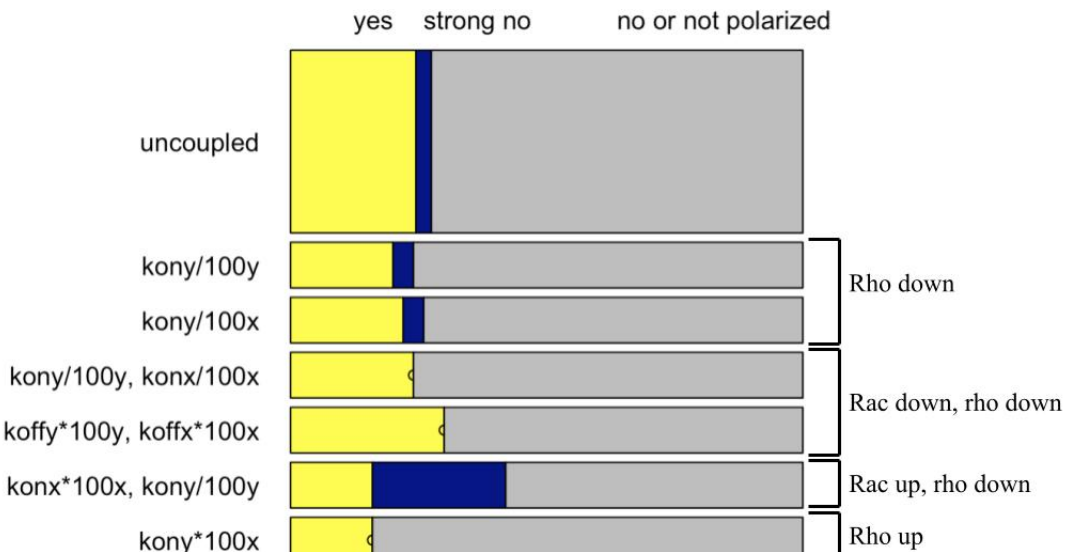
CIL AND COA

- CIL = Contact Inhibition of Locomotion; when cells are in contact, down-regulate rac and up-regulate rho so cells move away from each other
- COA = Co-attraction; when cells are nearby, up-regulate rac so cells move towards each other



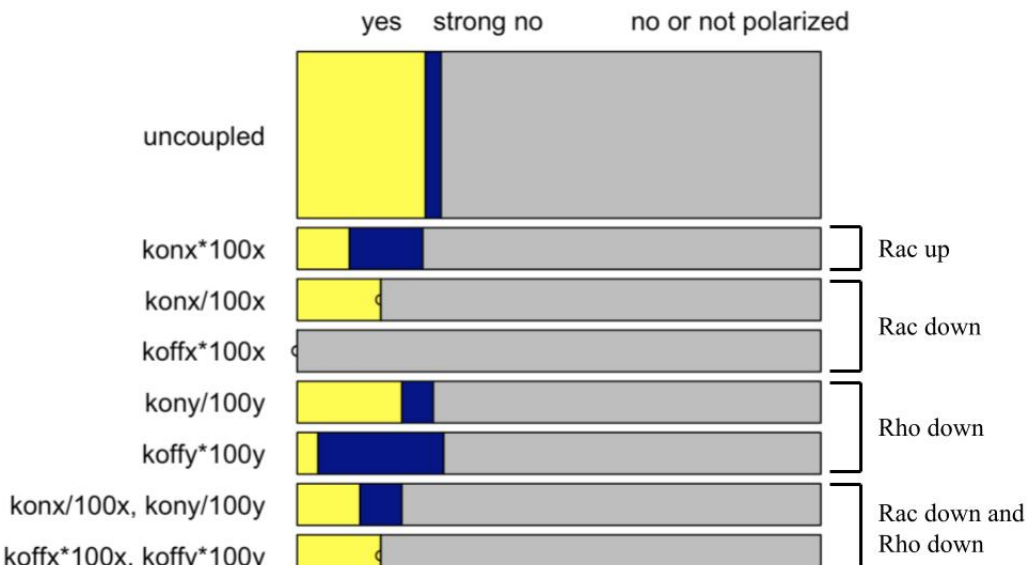
Rac/Rho Proportional to Itself

At each point in the contact region of cell 1, change the rac/rho binding/unbinding rate depending on the amount of rac/rho nearby in cell 1. Do the same for cell 2.



Rac/Rho Proportional to Other Cell

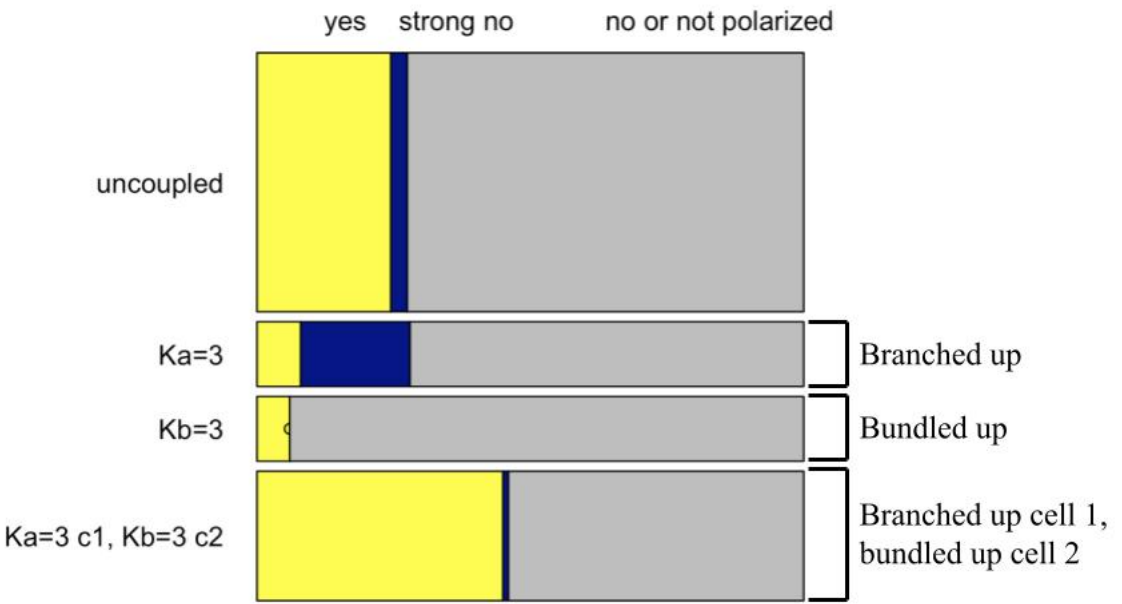
At each point in the contact region of cell 1, change the rac/rho binding/unbinding rate depending on the amount of rac/rho nearby in cell 2. Do the same for cell 2.



da/dt = Ka ((1-nrac)*a - a^2) - m0*a*b + diffusion
db/dt = Kb ((1-nrho)*b - b^2) - m0*a*b + diffusion

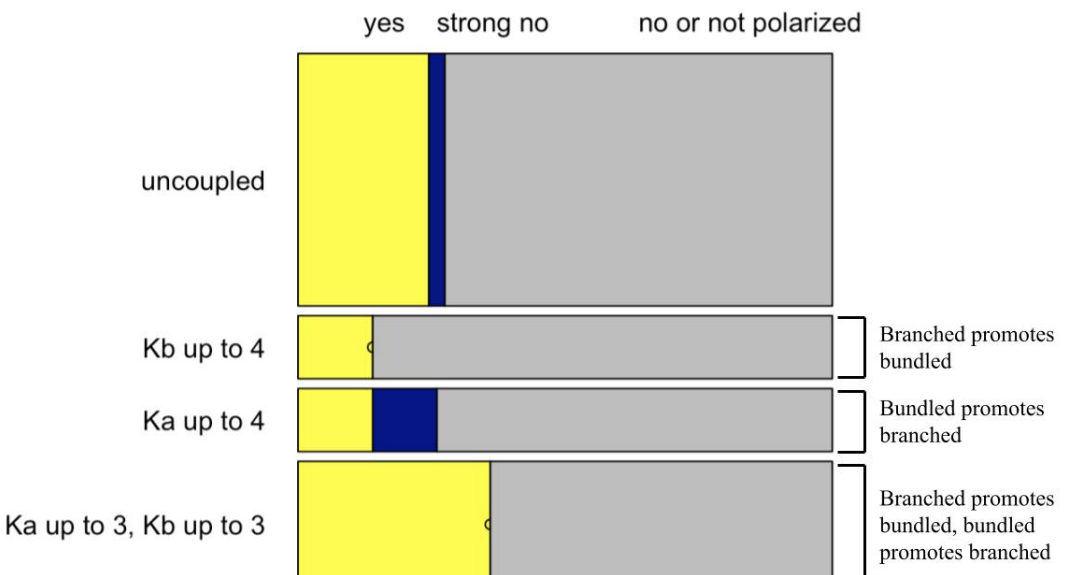
Branched/Bundled Actin Formation

Change the rate of branched or bundled actin formation by changing the coefficient K_a or K_b in the contact region.

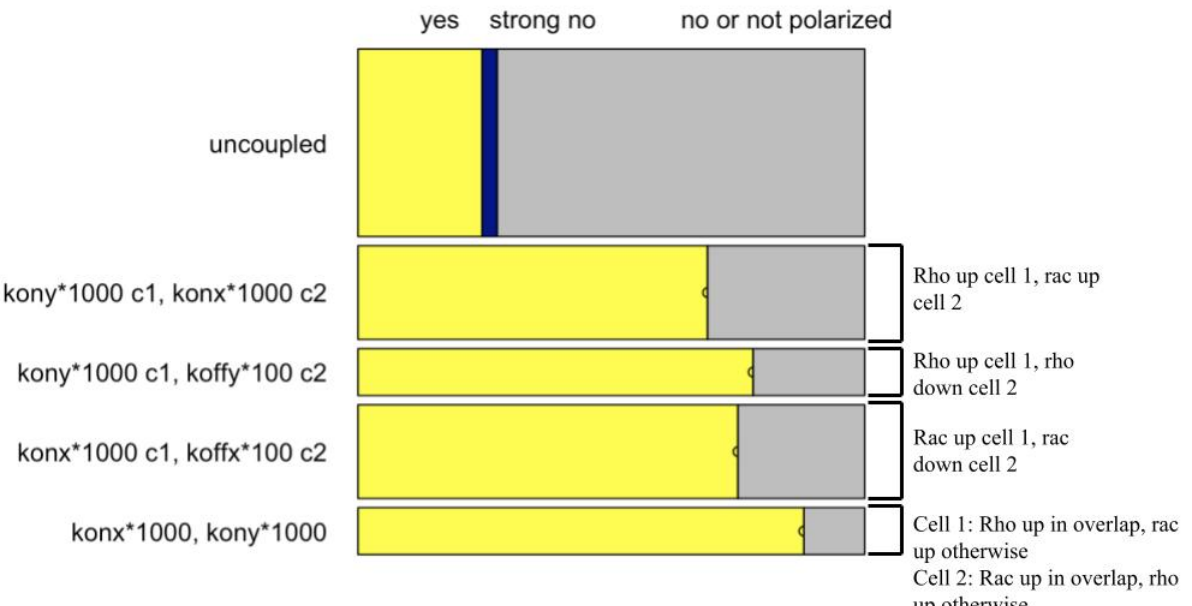


Branched/Bundled Proportional to Other Cell

At each point in the contact region of cell 1, change the branched/bundled coefficient depending on the amount of branched/bundled actin nearby in cell 2. Do the same for cell 2.



Rac/Rho Binding and Unbinding



Next: Adding Cadherins

- Add cadherins to incorporate more interaction between the two cells
- Cadherins will also bind and unbind from the cell membrane like rac and rho
- They will stabilize when both cells place cadherins near each other in the contact region
- Cells will place more rac in the areas with cadherins, so implement CIL in those spots