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Supplemental Information

Myosin Clusters of Finite Size Develop Contractile Stress in 1D Random Actin Arrays

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Supporting Material

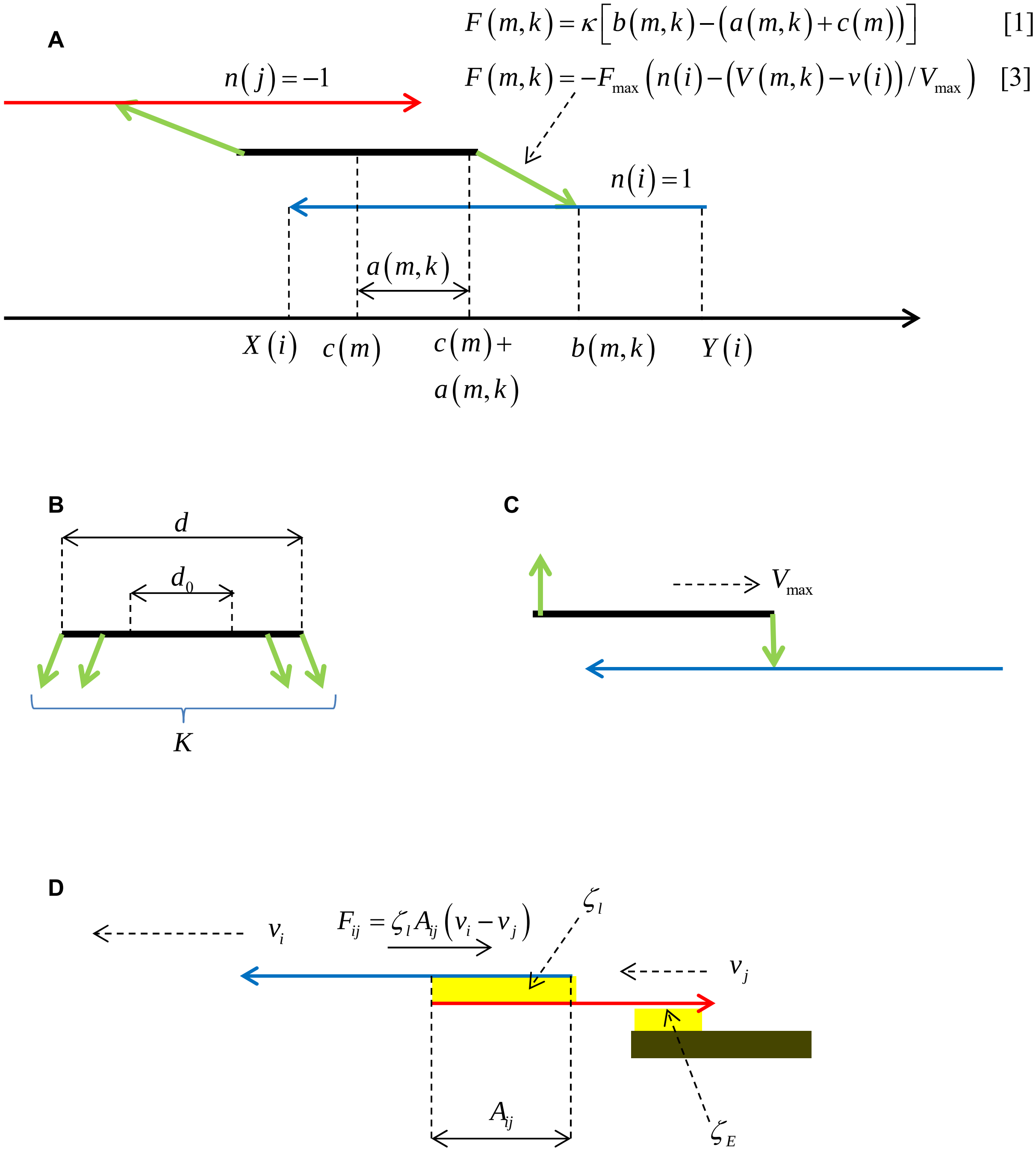

Figure S1: Schematics of the model. All notations are explained in Materials and Methods of the main text of the paper.

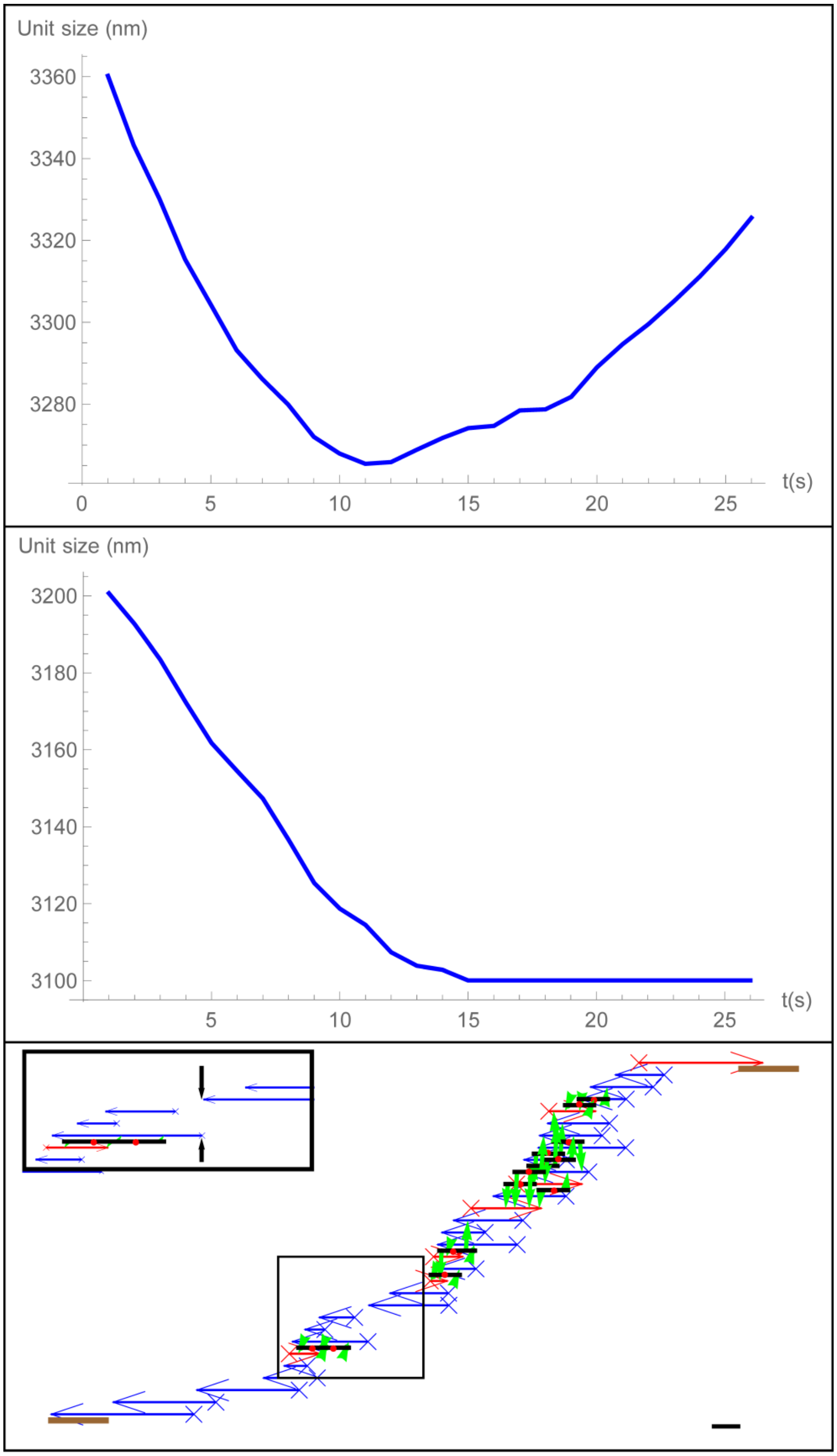

Figure S2: Examples from the simulations when the contraction stops short.

(A) Sample simulation shows CU length as a function of time without actin dynamics. Before the CU simulation starts, the contractile unit without length change undergoes filament turnover for some time to achieve a characteristic random equilibrium state. Initial $\bar{L}$ = 3.5 μm, L = 700 nm, d = 100 nm, ρ = 0.01/nm, $\zeta_l = 10^{-4}$ pN×s/nm^2.

(B) Sample simulation shows CU length as a function of time without filament exchange but with rapid pointed end depolymerization. Before the SFU simulation starts, the contractile unit without length change undergoes filament turnover and pointed end depolymerization for some time to achieve a characteristic random equilibrium state. Initial $\bar{L}$ = 3.5 μm, initial L = 700 nm, K =2, d = 100 nm, ρ = 0.01/nm, $\zeta_l = 10^{-4}$ pN×s/nm^2, r_d = 30 nm/s.

(C) Sample simulation (the data set from (B), t = 20 s) shows the hole developed in the CU. All notations are the same as in Fig. 2A. Black arrows in the inset indicate the hole. Bar: 100 nm.

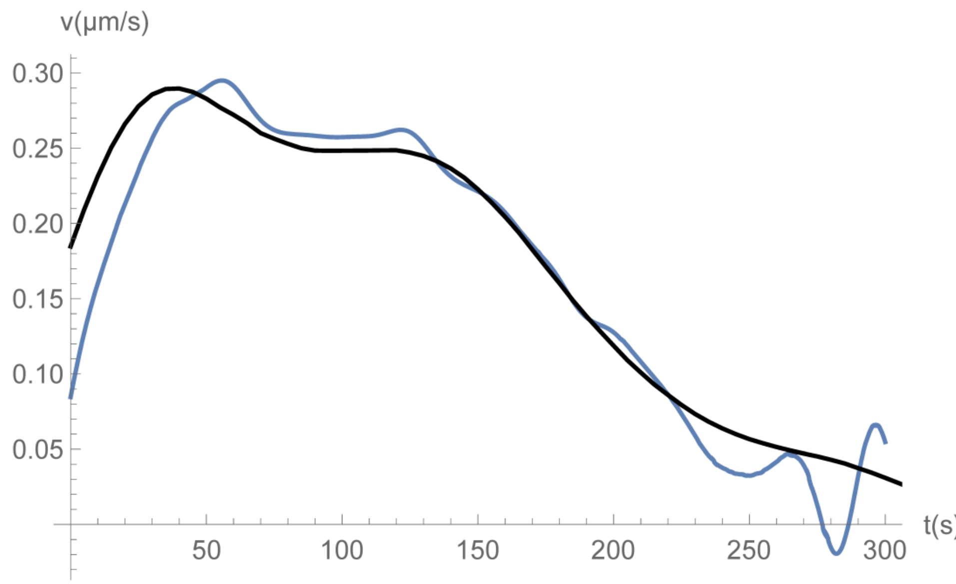

Figure S3: Experimentally measured contraction rate and theoretical fit. Contraction rate as a function of time for Caenorhabditis elegans contraction ring is shown with the grey curve. The data is provided by A. Carvalho lab; the same data was used in (30) to produce Fig. 5 in (30). The original data is for circumference of 32 rings. The ring perimeter was scaled to its initial value and then the average was computed. The averaged curve was smoothed using the low-pass filter with the cutoff frequency of 0.03 and kernel of the length 1/10 of the full time interval of contraction (300 s). The time derivative of the smoothed curve was computed numerically. The black curve shows the scaled average contraction rate from the CU model simulation, as described in the text. Note that in the simulations the ring contracts to 40% of the initial length, while in the experiment the ring contracts to 20% of the initial length.

Table S1: Model parameters; v: varied between simulations, specified in figure legends; nv: not varied between simulations.

m_{tot}	Total number of motor heads, v	~ 200
K	Number of motor heads per cluster, v	2 – 20
M	Number of myosin clusters, v	$M = m_{total} / K$
d	Myosin cluster length, v	~ 300 nm
d_0	Bare zone length, nv	~ 100 nm
κ	Motor head spring constant, nv	0.1 pN/nm
F_{max}	Myosin stall force, nv	1 pN
V_{max}	Free myosin gliding speed, nv	100 nm/s
ζ_l	Actin crosslinking viscous drag coefficient, v	$10^{-4} - 10^{-1}$ pN×s/nm^2
ζ_E	Effective viscous drag coefficient between the end segment and actin filament, v	$\zeta_E = 2\zeta_l$
ζ_{E0}	Effective viscous drag coefficient between the end segment and the surface, v	$\zeta_{E0} = \zeta_E$
$L, \delta L$	Mean and standard deviation of the actin filament length, v	~ 700 nm, 80 nm
r_{rem}	Rate of filament removal, v	~ 0.1 – 10/s
r_{add}	Rate of filament addition, v	~ 1 – 100/s
r_d	Disassembly rate at pointed ends, v	~ 5 – 20 nm/s
D	Length of the end adhesive segments, nv	250 nm
$\bar{L}$	Length of the contractile unit, v	~ 2 – 4 μm