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Supporting Information

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A Theoretical Description of Elastic Pillar Substrates in Biophysical Experiments

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Approximation of the interior force field

In this section we outline how the forces of filaments in the interior region of the substrate can be approximated from displacements and forces in the edge zones. To this end, we consider a rectangular filament network on top of a pillar substrate of size $2l_x \cdot 2l_y$ the center of which is at position $\left(l_x, l_y\right)$. The edge zones, inside which pillar displacements and filament force gradients are significantly larger than zero, are of lengths l_{ex} and l_{ey}, respectively. Generally, these lengths do not need to be identical as depicted in Figure 8. Furthermore, we assume that the initial pillar spacing l^0 and the pre-strain e^0 are identical in all rows and in all columns of the substrate. In this case, the deformation of the pillar substrate is equiangular meaning that initial directions in the network will be conserved. It is therefore possible to integrate force gradients along the conserved directions to obtain the forces in these directions. For the orthogonal examples considered here, we thus have to integrate rows along the *x*-direction and columns along the *y*-direction to evaluate forces in horizontal and vertical filaments, respectively. We also assume that forces are continuous across the border of the edge zones and that they are constant for all horizontal and all vertical filaments inside the interior region (Figure 1S): $F_{int,x} = const_1$, $F_{int,y} = const_2$. The forces can easily be approximated by integration of the force gradients, F', over and along the edge zones. To obtain the force in interior horizontal filaments, the integration is along the border of the edge zone in the *y*-direction, i.e. along $y = l_{ey}$, and over the length of the edge zone in the *x*-direction, i.e. from 0 to l_{ex} (see Figure 8) as shown in Equation (14):

$$\int_0^{l_{ex}} F_a'(x)dx = F(l_{ex}) - F(0) \approx F(l_{ex}) \approx F_{int,x}\,, \quad y = l_{ey} \tag{14}$$

and analogously for interior vertical filaments [Eq. (15)]:

$$\int_0^{l_{ey}} F_a'(y)dy \approx F(l_{ey}) \approx F_{int,y}\,, \quad x = l_{ex} \tag{15}$$

For clarity, we write forces and force gradients as functions of the integration variable, but it should be kept in mind that in general they depend on both variables: *x* and *y*.

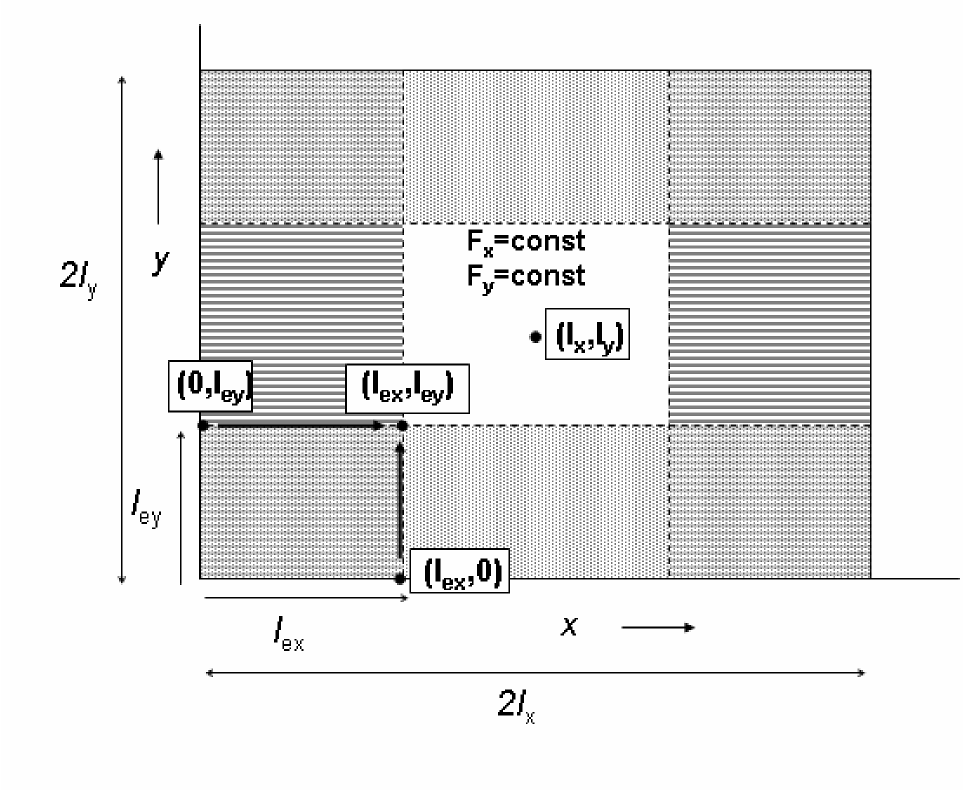

Figure 1S. Schematic drawing of a 2d substrate with dimensions $2l_x \cdot 2l_y$.The center (black circle) is at position (l_x, l_y). The edge zones in the *x*-direction (striped areas) expand over a length l_{ex} to either side of the substrate and in the *y*-direction (dotted areas) over a length l_{ey}. Only inside these zones are forces and force gradients expected to vary. In the interior region (white area) all forces along the *x*-direction and along the *y*-direction are assumed constant. For a symmetrically deformed substrate, it therefore suffices to calculate the forces at the lower left corner of the edge zones, i.e. in the region (l_{ex}, l_{ey}). This is done by integration of force gradients over the corresponding edge zones and along the edges in the *y*-and *x*-direction, respectively, (black arrows).