Reviewer #2: The authors present an investigation of the detachment of fibrillar adhesive arrays subject to normal loading via a system of rigid phalanges and flexible joints. Three primary cases are examined via an elastic spring model - a rigid joint with controlled angle of alignment to the surface, a free joint pulled from an initially aligned configuration, and a free joint supplemented by the presence of a claw hinge ahead on the opposite side of the fibril array. Both controlled misalignment and off-center free pulling are shown to generate a non-uniform load distribution, with progressive local detachments lowering the peak global force during the separation process. Most significantly, it is demonstrated that the presence of a claw hinge can reduce the detachment force beyond other modes by supplementing the moment generated by the pulling force.

While sound in approach, the central observation that a non-uniform distribution of load among fibrils will lower the peak force during detachment is already well-established in the literature (including papers cited in the manuscript itself). The authors statement in the conclusion section, that the 'model is supported by previously reported experimental observations' seems overstated. None of the specific detachment pathways studied using the model is directly evidenced in natural systems by reference to the literature, with only general 'twist of the leg' referred to in generation of a non-uniform load distribution. More specific and novel (to the reviewers knowledge) conclusions, such as the observation that the use of a claw hinge can further reduce the detachment force are not contextualized. In order to enhance the impact, it is suggested that this result be elaborated upon and related more specifically to the experimental literature.

Thank you for your kind feedback. Our central result is in fact more focused towards the 3 modes of detachment which can be used to tune adhesion by relying on specific conditions of the joints and claws, similar to a biological attachment system. We simply use the previously reported effect of 'non-uniform distribution of load among fibrils causing adhesion reduction' to support the mechanisms that we show in our work. That however shouldn't be considered as our main result. We acknowledge that this confusion arose due to the phrasing and structure of the conclusions section. Please check the rewritten section (page 20-21). Here, we also point out that the model is only partially supported by experiments found in literature so far. Regarding the effect of claws, we found that Gernay et. al.(10.1098/rsif.2017.0493, figure 4 of reference) also reports video recording showing how the beetle might use its claws to instantly drop itself. We have included this observation in the text as well to provide additional support. (see page 19 lines 15-18)

Further comment is given below on specific points in the manuscript which require further consideration and clarification.

Page 6, Line 9 - If the joint is free to rotate then then the change in length may be different in fibrils across the array. The following equations assert that Δl is the same for all fibrils. Is this stage of the modeling effort only relevant to a rigid joint, as this is not stated explicitly? If this is the case, the modification of this equation for other cases should be elaborated upon.

Thank you so much for pointing out this error. Yes, you are correct that *equation 6 was previously derived under the assumption of a rigid joint. We have now updated the derivation to account for the general scenario where the array can also rotate around the joint, thus causing a non-uniform recoil of fibrils. The updated equations however do not change our results for the 'free pull' case, since rotation of the array reduces Δl significantly enough to not induce a catastrophic failure (see equation 5 and 6 in page 6)*

Page 8, Line 4 - A description of the numerical procedure (starting point, displacement increment, re-computation of the stiffness upon fibril detachments etc.) by which the force displacement curves are obtained is absent, making reproduction of the results challenging.

The numerical procedure is now summarized (see page 8 lines 5-10). Additionally, the python scripts used for the simulations are made available in GitHub (see page7, line 5)

Page 9, Line 11 - The statement 'the hairs of the pad with a higher tilt angle' is misleading. If the joint is fixed then the angle of tilt is the same for all fibrils.

We agree. Rephrased as 'The pad with a higher tilt angle initiates hair detachment first, in comparison to a pad with a lower tilt.' (page 9 lines 16-18)

Page 12, Line 8 - The decision to focus only on the effective length of the claw should be more clearly explained. The distance of the hinge point would seem to be equally important. Additionally, the differing normalization of the lengths makes it confusing to interpret the differences in the moment arms without detailed consideration of the number of fibrils etc. This should be clarified.

We chose not to focus on the distance of the hinge point (s_h), since its effect should be trivial. Higher s_h increases the net lever arm, resulting in lower pulling force (as already noted in page 13, line 10). Thus we instead chose to vary the vertical length of the claw, as its effect is, in our opinion, more interesting due to the resulting hair deformations. Regarding the normalization, we have in general normalized all lengths w.r.t. w (hair spacing). Only for s_l, we chose to normalize w.r.t. the total length of the array, as one can intuitively imagine the position of the leg joint on the array from s_l/L values, irrespective of the number of fibrils (e.g. 0.5 being at the array centre, 1 being at the edge etc.). To alleviate any confusion, we have included $L = 24w$ in the text to remind the reader how L is defined. (page 12, line 8)

Page 13, Line 1 - The variable s does not appear in equation (4)

Variable s does appear inside parameter $\Psi = s - \frac{n-1}{2}w$ (defined earlier) which is in equation 4.

Page 13, Line 14 - 'Adhere' is a confusing choice of word here. A claw would presumably exploit mechanical interlocking/friction.

Rephrased as '...the claw should stick well with the surface, perhaps by mechanical interlocking, to resist...' (page 13 line 14-15)

Page 15, Line 15 - Stating that this is 'the advantage' of contact splitting is an oversimplification, with many cooperative mechanisms likely at play (see for example Kamperman et al., 2010, "Functional Adhesive Surfaces with 'Gecko' Effect: The Concept of Contact Splitting," Adv. Eng. Mater., 12(5), pp. 335-348.)

Here we intend to offer an additional support to the 'contact splitting' principle, which has been, to our knowledge, only discussed in literature with regards to the enhancement in adhesion. Here, we attempt to highlight that the same design principle also enhances the reversible nature of adhesion, if we follow the detachment mechanisms discussed in our work. The paragraph has thus been rephrased to: 'This highlights another advantage of having a split contact design found in many biological systems. A design comprising of a large number of hairs not only enhances the adhesion due to scaling effects \cite{Kamperman2010}, but could also offer a better control over adhesion, making it quite suitable for reversible attachment and detachment during locomotion.' (page15, line17)