I would rank this paper as a four. Any critiques I have are primarily superficial, and I have no serious faults with the content or its structure. It might not be a groundbreaking paper, but it is an engaging and thoughtful overview of DEAs. The introduction makes a compelling argument for the usage of DEAs, the applications are all well explained with quality descriptions of the problem each paper or application is solving, and the challenges section lays out plenty of potential future works. I have been reading quite a few review style papers, and this was notably more successful at providing a digestible overview of the field.

The “novelty” of this kind of paper is the collection and categorization of a broad field of works. Since the authors are not contributing new works, the benefit is their analysis and discussion of the successes and failures of their academic peers. In particular this paper has an excellent section on challenges and potential for future work. They address the difficulties that DEAs encounter in fabrication, control, and general improvement. This section tells the story of what has been done to address certain downsides of the actuators as well as what could be done to continue to see them improve. This makes the paper a fantastic resource for finding courses of study or generating potential ideas for innovations. The primary contribution of the review is that it can serve to help new researchers in the field find novel, beneficial works to pursue.

I see the paper having a few primary strengths. The introduction and motivation for the usage of DEAs in robotics is very compelling. From the start, the benefits of using DEAs is clear as they provide faster and lighter actuation than most of their soft counterparts but maintaining all of the compliance and flexibility that makes soft actuation so beneficial. To that end the introduction of the paper is a well written hook that is then followed by well written applications that carry the momentum into the actual material of the review. Each section on the usage is able to maintain the interest of the reader while providing what I found to be intuitive descriptions that coupled with the images to make for a very manageable read that avoids feeling dense while still being comprehensive. The other strength of this paper is its discussion of the challenges facing DEAs at both a high and a low level. By breaking section three “Challenges and Perspectives” down into the big ideas that plague dielectric actuation (high voltages, having compliant electrodes, the inclusion of sensors into DEAs, etc.) and then breaking down the current approaches to resolving the issues feels like a great way to discuss the topic. It provides for context on the big goal while comparing specific implementations.

In terms of failings of the paper I was primarily disappointed at the arrangement of the reference images, and the conclusions section is relatively weak. The reference images were often not on the same page as the section they were discussing, which is relatively minor, but did lead to some confusion when I was trying to find the robots that were being referenced. The distribution of images is also a place for improvement as section three is a block of unbroken text for several pages while there is an entire page of images just after section two. It makes for a bit of a stilted flow through the paper. Finally, the conclusion section doesn’t feel conclusive but rather summative. A lot of what was discussed didn’t seem to be important enough to really be a conclusion, and I think the paper would have benefitted from a more analytical discussion at the end.

The concept of a DEA is relatively new to me, and while the idea is straightforward the actual implementation seems difficult to find the right spot to use it. However, since the general idea of the actuator is to squeeze a material and then spread it out, it does make me wonder about directional squeezing. By having a evenly inflated starting pose and then applying force unevenly it could be possible to use a DEA to generate omnidirectional force just using specific applications of voltage. For example, if you applied force to an electrode that was angled or could be angled specifically then that could create controllable direction of expansion. I also had a thought that instead of loose carbon powder or some other fluid/semifluid element as an electrode that it might be possible to utilize some form of electrode net. If the electrodes were connected to each other by a flexible material, they could stretch along with the elastomer body. This would have to be attached then to another element to compress the actuator, but for small enough applications a sufficiently complex network might be able to recreate the desired effect.