

4. Conclusions

As a result of the literature reviews we compare the four types of actuators according to their material that are used in the actuator body, additional material that are used in application, number of production steps, the number of equipments, reproducibility and actuator functions.

All of the soft robots are produced by soft materials but there isn't any system which is completely soft. In all systems even if actuators can be completely soft, but all additional components are rigid.

Pneumatic bending actuators is the most reproducible actuators, but they have minimum functionality. According to production steps, generally an actuator which has more steps has more function seems.

The most determinative topics for usage of the actuator are reproducibility and functions. According to these topics the most useful actuator type is fiber reinforced. This type of actuators have three types functions and also combine of these functions and one advantage of these type of actuator is not requiring any assist component.

5. References

- [1] J. A. Gallego, E. Rocon, J. Ibanez, J. L. Dideriksen, A. D. Koutsou, R. Paradiso, M. B. Popovic, J. M. Belda-Lois, F. Gianfelici, D. Farina, and others, "A soft wearable robot for tremor assessment and suppression," in *Robotics and Automation (ICRA)*, 2011 IEEE International Conference on, 2011, pp. 2249–2254.
<http://dx.doi.org/10.1109/icra.2011.5979639>
- [2] P. Maeder-York, T. Clites, E. Boggs, R. Neff, P. Polygerinos, D. Holland, L. Stirling, K. Galloway, C. Wee, and C. Walsh, "Biologically Inspired Soft Robot for Thumb Rehabilitation," *J. Med. Devices*, vol. 8, no. 2, p. 020933, 2014.
<http://dx.doi.org/10.1115/1.4027031>
- [3] S. A. Morin, R. F. Shepherd, S. W. Kwok, A. A. Stokes, A. Nemiroski, and G. M. Whitesides, "Camouflage and Display for Soft Machines," *Science*, vol. 337, no. 6096, pp. 828–832, Aug. 2012.
<http://dx.doi.org/10.1126/science.1222149>
- [4] C. D. Onal and D. Rus, "Autonomous undulatory serpentine locomotion utilizing body dynamics of a fluidic soft robot," *Bioinspir. Biomim.*, vol. 8, no. 2, p. 026003, Jun. 2013.
<http://dx.doi.org/10.1088/1748-3182/8/2/026003>
- [5] A. D. Marchese, C. D. Onal, and D. Rus, "Towards a Self-contained Soft Robotic Fish: On-Board Pressure Generation and Embedded Electro-permanent Magnet Valves," in *Experimental Robotics*, vol. 88, J. P. Desai, G. Dudek, O. Khatib, and V. Kumar, Eds. Heidelberg: Springer International Publishing, 2013, pp. 41–54.
- [6] K.-J. Cho, J.-S. Koh, S. Kim, W.-S. Chu, Y. Hong, and S.-H. Ahn, "Review of manufacturing processes for soft biomimetic robots," *Int. J. Precis. Eng. Manuf.*, vol. 10, no. 3, pp. 171–181, Jul. 2009
<http://dx.doi.org/10.1007/s12541-009-0064-6>.
- [7] R. F. Shepherd, F. Ilievski, W. Choi, S. A. Morin, A. A. Stokes, A. D. Mazzeo, X. Chen, M. Wang, and G. M. Whitesides, "Multigait soft robot," *Proc. Natl. Acad. Sci.*, vol. 108, no. 51, pp. 20400–20403, 2011.
<http://dx.doi.org/10.1073/pnas.1116564108>
- [8] JFPS International Symposium on Fluid Power and Japan Fluid Power System Society, Eds., *The 6th JFPS International Symposium on Fluid Power Tsukuba 2005 November 7-10*. Tokyo: The Japan Fluid Power System Society, 2005.
- [9] E. Rocon, J. M. Belda-Lois, A. F. Ruiz, M. Manto, J. C. Moreno, and J. L. Pons, "Design and Validation of a Rehabilitation Robotic Exoskeleton for Tremor Assessment and Suppression," *IEEE Trans. Neural Syst. Rehabil. Eng.*, vol. 15, no. 3, pp. 367–378, Sep. 2007.
<http://dx.doi.org/10.1109/TNSRE.2007.903917>

