Publications, patents and lectures

PD Dr. rer. nat. habil. Simon Poppinga

Recent features of my research can be found here, here, and here.

Patents

Invention disclosure **VA-CO 2021-22-2021 – Bionischer Sauggreifer**. Inventors: Harald Kuolt, Thomas Speck, Simon Poppinga, Tim Kampowski. Invention disclosure: 12.2021

EP 2320015 – Hingeless, infinitely deformable folding mechanism. Inventors: Knippers J, Lienhard J, Schleicher S, Poppinga S, Masselter T, Speck T. Patent application: 10.11.2009, EP20060743126 / Patent disclosure: 11.05.2011, EP 2 320 015 A2 / Grant of patent: 13.08.2020 (for D, A, CH)

378 003 P-EP – Gelenkloser, stufenlos verformbarer Klappmechanismus. Inventors: Knippers J, Lienhard J, Schleicher S, Poppinga S, Masselter T, Speck T. Patent application: 10.11.2009

Peer-reviewed publications

75 **Speck T, Cheng T, Klimm F, Menges A, Poppinga S, Speck O, Tahouni Y, Tauber F, Thielen M (2022)** Plants as inspiration for material-based sensing and actuation in soft robots and machines. *MRS Bulletin* (revision submitted)

74 **Horstmann M, Buchheit H, Speck T, Poppinga S (2022)** The cracking of Scots pine (*Pinus sylvestris*) cones. *Frontiers in Plant Science* **13**: 982756. DOI: 10.3389/fpls.2022.982756

73 **Poppinga S, Knorr N, Ruppert S, Speck T (2022)** Chemonastic stalked glands in the carnivorous rainbow plant *Byblis gigantea* LINDL. (Byblidaceae, Lamiales). *International Journal of Molecular Sciences* **23**: 11514. DOI: https://doi.org/10.3390/ijms231911514

72 **Durak GM, Speck T, Poppinga S (2022)** Shapeshifting in the Venus flytrap (*Dionaea muscipula*): morphological and biomechanical adaptations and the potential costs of a failed hunting cycle. *Frontiers in Plant Science* **13**: 970320. DOI: 10.3389/fpls.2022.970320

71 **Kruppert S, Horstmann M, Weiss LC, Konopka E, Kubitza N, Poppinga S, Westermeier AS, Speck T, Tollrian R (2022)** Facing the green threat: a waterflea's defenses against a carnivorous plant. *International Journal of Molecular Sciences* **23**: 6474. DOI: 10.3390/ijms23126474. **Preprint**: bioRxiv. DOI: 10.1101/2021.10.19.464940

70 **Durak GM, Thierer R, Sachse R, Bischoff M, Speck T, Poppinga S (2022)** Smooth or with a snap! Biomechanics of trap reopening in the Venus flytrap (*Dionaea muscipula*). *Advanced Science* **9**: 2201362. DOI: 10.1002/advs.202201362. **Back cover**: *Advanced Science* **9**: 2270140. DOI: 10.1002/advs.202270140

69 **Eger CJ, Horstmann M, Poppinga S, Sachse R, Thierer R, Nestle N, Bruchmann B, Speck T, Bischoff M, Rühe J (2022)** The structural and mechanical basis for passive-hydraulic pine cone actuation. *Advanced Science* **9**: 2200458. DOI: 10.1002/advs.202200458

68 **Kampowski T, Schuler B, Speck T, Poppinga S (2022)** The effects of substrate porosity, mechanical substrate properties and loading conditions on the attachment performance of the Mediterranean medicinal leech (*Hirudo verbana*). *Journal of the Royal Society Interface* **19**: 20220068. DOI: 10.1098/rsif.2022.0068

67 **Speck T, Poppinga S, Speck O, Tauber F (2022)** Bio-inspired life-like motile materials systems: changing the boundaries between living and technical systems in the Anthropocene. *The Anthropocene Review* **9**: 237–256. DOI: 10.1177/20530196211039275

66 **Carmesin CF, Fleischmann AS, Klepsch MM, Westermeier AS, Speck T, Jansen S, Poppinga S (2021)** Structural gradients and anisotropic hydraulic conductivity in the enigmatic eel traps of carnivorous corkscrew plants (*Genlisea*, Lentibulariaceae). *American Journal of Botany* **108**: 2356–2370. DOI: 10.1002/ajb2.1779

65 **Bauer U, Müller U, Poppinga S (2021)** Complexity and diversity of motion amplification and control strategies in motile carnivorous plant traps. *Proceedings of the Royal Society B* **288**: 20210771. DOI: 10.1098/rspb.2021.0771

64 **Horstmann M, Fleischmann A, Tollrian R, Poppinga S (2021)** Snapshot prey spectrum analysis of the phylogenetically early-diverging carnivorous *Utricularia multifida* from *U*. section *Polypompholyx* (Lentibulariaceae). *PLoS ONE* **16**: e0249976. DOI: 10.1371/journal. pone.0249976

63 **Poppinga S, Schenk P, Speck O, Speck T, Bruchmann B, Masselter T (2021)** Self-actuated paper and wood models: low-cost handcrafted biomimetic compliant systems for research and teaching. *Biomimetics* **6**: 42. DOI: 10.3390/biomimetics6030042

62 **Cheng T, Thielen M, Poppinga S, Tahouni Y, Wood D, Steinberg T, Menges A, Speck T (2021)** Bio-inspired motion mechanisms: computational design and material programming of 4D-printed wearable systems. *Advanced Science* **8**: 2100411. DOI: 10.1002/advs.202100411

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60 **Kuolt H, Kampowski T, Poppinga S, Speck T, Tautenhahn T, Moosavi A, Weber J, Gabriel F, Pierri E, Dröder K (2021**) *Biomimetic suction cups for energy-efficient industrial applications*. In: K. Dröder & T. Vietor (eds.), Technologies for economic and functional lightweight design: Conference proceedings 2021, 182–188. Springer-Vieweg. ISBN: 978-3-662-62923-9. DOI: 10.1007/978-3-662-62924-6_15

59 **Westermeier AS, Hiss N, Speck T, Poppinga S (2020)** Functional-morphological analyses of the delicate snap-traps of the aquatic carnivorous waterwheel plant (*Aldrovanda vesiculosa*) with 2D and 3D imaging techniques. *Annals of Botany* **126**: 1099–1107. DOI: 10.1093/aob/mcaa135

58 **Kampowski T, Thiemann L-L, Kürner L, Speck T, Poppinga S (2020)** Exploring the attachment of the Mediterranean medicinal leech (*Hirudo verbana*) to porous substrates. *Journal of the Royal Society Interface* **17**: 20200300. DOI: 10.1098/rsif.2020.0300

57 **Sachse R & Westermeier A, Mylo M, Nadasdi J, Bischoff M, Speck T, Poppinga S (2020)** Snapping mechanics of the Venus flytrap (*Dionaea muscipula*). *Proceedings of the National Academy of Sciences USA* **117**: 16035–16042. DOI: 10.1073/pnas.2002707117

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55 **Bauer U, Poppinga S, Müller UK (2020)** Mechanical ecology - Taking biomechanics to the field. *Integrative and Comparative Biology* **60**: 820–828. DOI: 10.1093/icb/icaa018

54 **Kuolt H, Kampowski T, Poppinga S, Speck T, Moosavi A, Tautenhahn R, Weber J, Gabriel F, Pierri E, Dröder K (2020)** Increase of energy efficiency in vacuum handling systems based on biomimetic principles. In: *Proceedings of the 12th International Fluid Power Conference* (12. IFK). Volume 3. Dresden: Technische Universität Dresden, pp. 17–26. DOI: 10.25368/2020.89.

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52 **Correa D & Poppinga S, Mylo MD, Westermeier AS, Bruchmann B, Menges A, Speck T (2020)** 4D pine scale: biomimetic 4D printed autonomous scale and flap structures capable of multi-phase movement. *Philosophical Transactions of the Royal Society A* **37**: 20190445. DOI: 10.1098/rsta.2019.0445

51 **Poppinga S, Smaij J, Westermeier AS, Horstmann M, Kruppert S, Tollrian R, Speck T (2019)** Prey capture analyses in the carnivorous aquatic waterwheel plant (*Aldrovanda vesiculosa* L., Droseraceae). *Scientific Reports* **9**: 18590. DOI: 10.1038/s41598-019-54857-w

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48 **Hesse L, Leupold J, Poppinga S, Wick M, Strobel K, Masselter T, Speck T (2019)** Resolving form-structure-function relationships in plants with MRI for biomimetic transfer. *Integrative and Comparative Biology* **59**: 1713–1726. DOI: 10.1093/icb/icz051

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44 **Kampowski T, Demandt S, Poppinga S, Speck T (2018)** Kinematical, structural and mechanical adaptations to desiccation in poikilohydric *Ramonda myconi* (Gesneriaceae). *Frontiers in Plant Science* **9**: 1701. DOI: 10.3389/fpls.2018.01701

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42 **Gallenmüller F, Langer M, Poppinga S, Kassemeyer H-H, Speck T (2018)** Spore liberation in mosses revisited. *AoB PLANTS* **10**: plx075. DOI: 10.1093/aobpla/plx075

41 **Nestle N, Šandor A, Bruchmann B, Speck T, Gallenmüller F, Poppinga S (2018)** Fossilized but functional – Tomographic insights into nature's most resilient actuators. *Proceedings of the Bruker Micro-CT User Meeting* **2018**: 49–55.

40 **Kampowski T, Mylo MD, Poppinga S, Speck T (2018)** How water availability influences morphological and biomechanical properties in the one-leaf plant *Monophyllaea horsfieldii* R.Br.. *Royal Society Open Science* **5**: 171076. DOI: 0.1098/rsos.171076

39 **Poppinga S, Zollfrank C, Prucker O, Rühe J, Menges A, Cheng T, Speck T (2018)** Toward a new generation of smart biomimetic actuators for architecture. *Advanced Materials* **30**: 1703653. DOI: 10.1002/adma.201703653. **Back cover**: *Advanced Materials* **30**: 1870135. DOI: 10.1002/adma.201870135

38 **Körner A, Born L, Mader A, Sachse R, Saffarian S, Westermeier AS, Poppinga S, Bischoff M, Gresser GT, Milwich M, Speck T, Knippers J (2018)** Flectofold – a biomimetic compliant shading device for complex free form facades. *Smart Materials and Structures* **27**: 017001. DOI: 10.1088/1361-665X/aa9c2f

37 **Poppinga S, Bauer U, Speck T, Volkov AG (2018)** Motile traps. In: Ellison AM, Adamec L (eds.), *Carnivorous plants - Physiology, ecology, and evolution*. Oxford University Press, pp. 180–193. DOI: 10.1093/oso/9780198779841.003.0014

36 **Bauer U, Jetter R, Poppinga S (2018)** Non-motile traps. In: Ellison AM, Adamec L (eds.), *Carnivorous plants - Physiology, ecology, and evolution*. Oxford University Press, pp. 194–206. DOI: 10.1093/oso/9780198779841.003.0015

35 **Kampowski T, Mylo MD, Speck T, Poppinga S (2017)** On the morphometry, anatomy and water stress behaviour of the anisocotyledonous *Monophyllaea horsfieldii* (Gesneriaceae) and their eco-evolutionary significance. *Botanical Journal of the Linnean Society* **185**: 425–442. DOI: 10.1093/botlinnean/box063

34 **Bischoff M, Sachse R, Westermeier AS, Körner A, Born L, Poppinga S, Gresser GT, Speck T, Knippers J (2017)** Modeling and analysis of the trapping mechanism of *Aldrovanda vesiculosa* as biomimetic inspiration for façade elements. In: Bögle A, Grohmann M (eds.), *IASS Annual Symposium 2017 Interfaces: architecture.engineering.science*, 25–28th September, Hamburg, Germany.

33 **Born L, Körner A, Schieber G, Westermeier AS, Poppinga S, Sachse R, Bergmann P, Betz O, Bischoff M, Speck T, Knippers J, Milwich M, Gresser GT (2017)** Fiber-reinforced plastics with locally adapted stiffness for bio-inspired hingeless, deployable architectural systems. In: Herrmann A (eds.), *21st Symposium on Composites*, Vol. 742: Trans Tech Publications (Key Engineering Materials), pp. 689–696. DOI: 10.4028/www.scientific.net/KEM.742.689

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31 **Poppinga S, Daber LE, Westermeier AS, Kruppert S, Horstmann M, Tollrian R, Speck T (2017)** Biomechanical analysis of prey capture in the carnivorous Southern bladderwort (*Utricularia australis*). *Scientific Reports* **7**: 1776. DOI: 10.1038/s41598-017-01954-3

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29 **Adamec L, Poppinga S (2016)** Measurement of the critical negative pressure inside traps of aquatic carnivorous *Utricularia* species. *Aquatic Botany* **133**: 10–16. DOI: 10.1016/j.aquabot.2016.04.007.

28 **Poppinga S, Kampowski T, Metzger A, Speck O, Speck T (2016**) Comparative kinematical analyses of Venus flytrap (*Dionaea muscipula*) snap-traps. *Beilstein Journal of Nanotechnology* **7**: 664–674. DOI: 10.3762/bjnano.7.59

27 **Speck T, Masselter T, Poppinga S, Thielen M, Bauer G, Bunk K, Hesse L, Schmier S, Westermeier AS (2016)** Fibres in biology and technology: smart fibre-reinforced materials and structures inspired by plants and animals. In: *Proceedings of the ECCM17 - 17th European Conference on Composite Materials*, Munich, Germany, 26-30th June 2016 (ISBN 978-3-00-053387-7).

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25 **Poppinga S, Weißkopf C, Westermeier AS, Masselter T, Speck T (2016)** Fastest predators in the plant kingdom: functional morphology and biomechanics of suction traps found in the largest genus of carnivorous plants. *AoB PLANTS* **8**: plv140. DOI: 10.1093/aobpla/plv140

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21 **Poppinga S, Metzger A, Speck O, Masselter T, Speck T (2013)** Schnappen, schleudern, saugen: Fallenbewegungen fleischfressender Pflanzen. *Biologie in unserer Zeit* **43**: 352–361. DOI: 10.1002/biuz.201310520

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18 **Hartmeyer S, Hartmeyer I, Masselter T, Seidel R, Speck T, Poppinga S (2013)** Catapults into a deadly trap: The unique prey capture mechanism of Drosera glanduligera. *Carnivorous Plant Newsletter* **42**: 4–14.

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13 **Schleicher S, Lienhard J, Knippers J, Poppinga S, Masselter T, Speck T (2011**) Bio-inspired kinematics of adaptive shading systems for free form facades. In: Nethercot D et al. (eds), *Proceedings of the 35th Annual Symposium of IABSE / 52nd Annual Symposium of IASS / 6th International Conference on Space Structures 'Taller Longer Lighter - Meeting growing demand with limited resources'*, London, UK, 0551.

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8 **Poppinga S, Lienhard J, Masselter T, Schleicher S, Knippers J, Speck T (2010)** Biomimetic deployable systems in architecture. In: Lim CT, Goh JCH (eds.), *IFMBE Proceedings 31, 6th World Congress on Biomechanics (WCB) 2010*, Singapore, pp. 40–43. DOI: 10.1007/978-3-642-14515-5_11

7 **Poppinga S, Masselter T, Lienhard J, Schleicher S, Knippers J, Speck T (2010)** Plant movements as concept generators for deployable systems in architecture. In: Brebbia CA (ed.), *Design & Nature V: Comparing Design in Nature with Science and Engineering*, WIT Press, Southampton, Boston, pp. 403–409. DOI: 10.2495/DN100351

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3 **Rembold K, Irmer A, Poppinga S, Rischer H, Bringmann G (2010)** Propagation of *Triphyophyllum peltatum* (Dioncophyllaceae) and observations on its carnivory. *Carnivorous Plant Newsletter* **39**: 71–77.

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Further publications

48 **Bauer U, Poppinga S (2022)** New insights and opportunities from taking a biomechanical perspective on plant ecology. *Journal of Experimental Botany* **73**: 1063–1066. DOI: 10.1093/jxb/erac007 (editorial for the JXBot special issue "Mechanical ecology – Taking biomechanics to the field").

47 **Müller UK, Poppinga S (2020)** Form, structure, and function: How plants vs. animals solve physical problems. *Integrative and Comparative Biology* **60**: 815–819. DOI: 10.1093/icb/icaa118

46 **Kampowski T, Poppinga S, Speck T (2020)** Steigerung der Energieeffizienz industrieller Vakuumhandhabungsprozesse mit Hilfe bionischer Wirkprinzipien. In: *Freiburger Materialforschungszentrum (FMF) Report 2020*, FMF, Freiburg.

45 **Kampowski T, Poppinga S, Speck T (2020)** Increasing the energy efficiency of industrial vacuum handling processes using biomimetic approaches. In: *Freiburger Materialforschungszentrum (FMF) Report 2020*, FMF, Freiburg.

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Lectures, posters, and further conference contributions

(K) Keynote lecture, (*T) invited talk, (T) regular talk, (Pa) panel discussion, (ST) short talk accompanying poster, (P) poster. Presenter(s) is/are underlined when several authors are listed.

2022 (*T) „A biomechanical perspective on stress response and resilience of plants". Talk in the symposium „Stress response and resilience of plants and ecosystems", Ulm University, 9.11.2022.

(*T) „Schnappen, klappen, schleudern – Wie Pflanzen sich bewegen und die Technik inspirieren". Studienstiftung project week in Weimar, 27.09.2022.

(*T) „Baubionik – Botanik inspiriert Architektur". Vortragsreihe des Freundeskreises des Botanischen Gartens der TU Darmstadt, 15.09.2022

(T*) „Schnappen, klappen, schleudern – Wie Pflanzen sich bewegen und die Technik inspirieren". Biological colloquium, TU Darmstadt, 14.07.2022.

(*T) „Schnappen, klappen, schleudern – Wie Pflanzen sich bewegen und die Technik inspirieren". Vorlesungsreihe „Was steckt dahinter?", TU Darmstadt, 24.05.2022.

(*T) „Wie fleischfressende Pflanzen ihre Beute fangen“. Vortragsreihe des Freundeskreises des Botanischen Gartens der TU Darmstadt, 19.05.2022.

2021 (*T) Poppinga S (2021) Plant movement physics and biomimetics. Botany Seminars @ LMU Munich, online presentation, 01.12.2021.

(*T) Poppinga S (2021) Plant movement biomimetics: Blurring the frontiers between living and technical systems. BASF-JONAS Family Days, online presentation, 24.09.2021.

2020 (*T) Poppinga S (2020) Suckers, snappers, and catapults: How carnivorous plants catch their prey. Monday Seminar series @ Department of Systematic and Evolutionary Botany, University of Zürich (online presentation), 12.10.2020.

(*Pa) Poppinga S (2020) Panel on smart buildings/adaptive architecture. The Convergence Center for Living Multifunctional Material Systems (LiMC2) webinar, July 23 (online)

(*T) Poppinga S (2020) Plant movements as models for novel bioinspired façade shading systems I. The Convergence Center for Living Multifunctional Material Systems (LiMC2) webinar, July 22 (online)

(*T) Poppinga S (2020) Schnappen, saugen, schleudern: Wie fleischfressende Pflanzen ihre Beute fangen. Biologisches Kolloquium Universität Ulm, AG Jansen, 28.01.2020.

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2019 (*T) Poppinga S (2019) Wie Pflanzen sich bewegen und die Architektur inspirieren. Waldhaus Freiburg, 17.10.2019

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(P) Westermeier A, Poppinga S, Speck T (2019) Visualisation of delicate plant soft tissue via µ-computer tomography: the snap-traps of the carnivorous aquatic *Aldrovanda vesiculosa* as a case study. Plant Biology CS 2019, Budweis, Czech Republic.

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(*T) Poppinga S, Kampowksi T, Speck T (2019) Structural, mechanical, and kinematical adaptations to desiccation. 2nd FAPESP-DFG joint workshop on desiccation-tolerant Velloziaceae from tropical inselbergs: a model family for better understanding species evolution on terrestrial islands. 25th-29th March 2019, Rostock, Germany

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