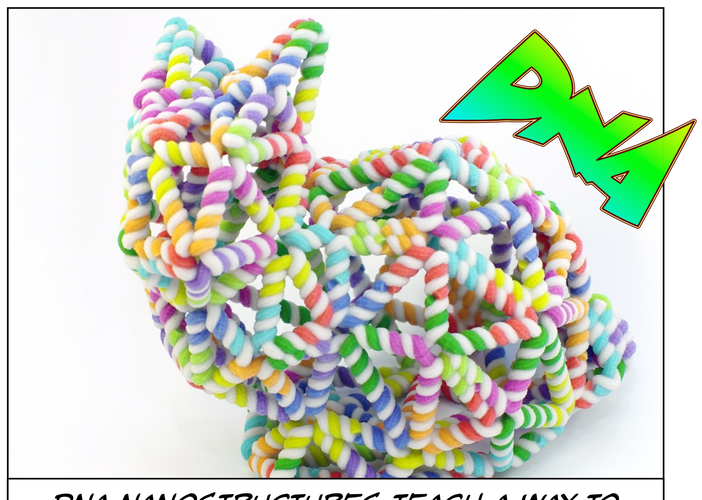
Wireframes from Z-Bent Springs

James Mallos, Sculptor. Washington DC. jbmallos@gmail.com

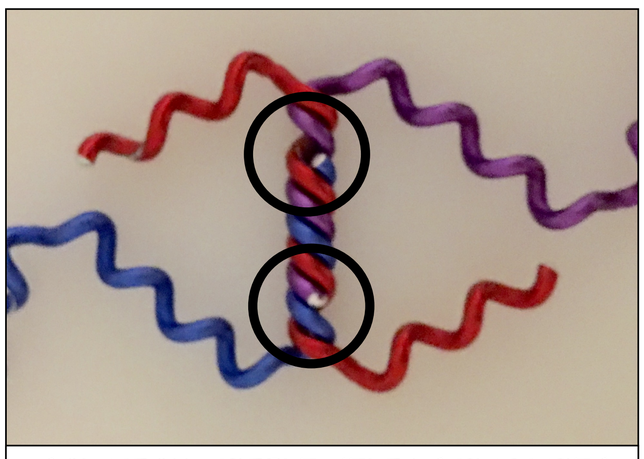
USUAL WAYS OF MAKING WIREFRAMES ARE NOT SUITED TO DIGITAL FABRICATION

DIGITAL WIRE-BENDING IS FAST, INEXPENSIVE—AND WIRE IS STRONG

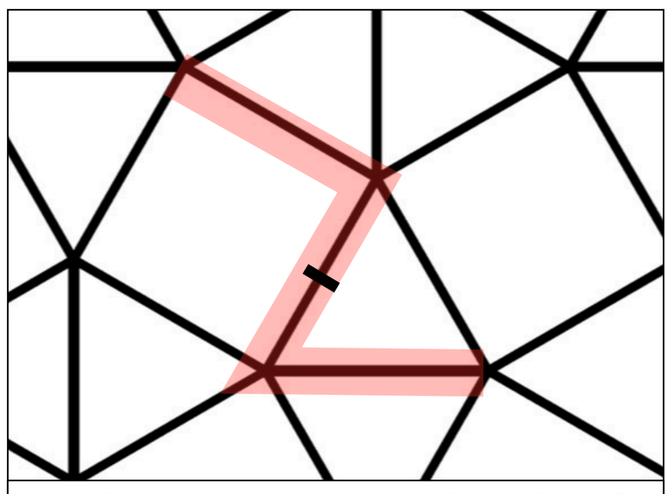


DNA NANOSTRUCTURES TEACH A WAY TO MAKE FRAMES FROM DOUBLE HELICES...

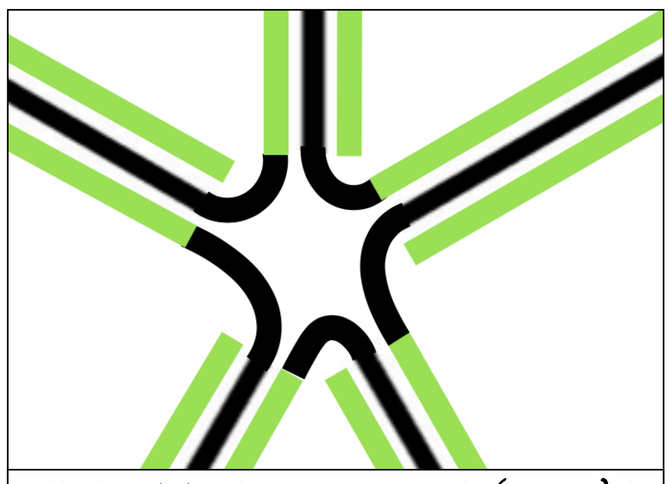
...BUT, DOUBLE HELIX STRUCTURES ARE WEAKENED BY A SPLICE AT CENTER OF EACH STRUT



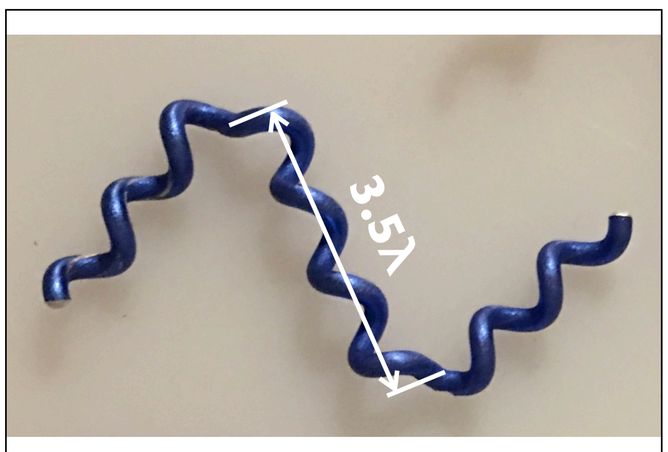
SOLUTION: TRIPLE HELIX STRUCTURES CAN PLACE THEIR SPLICES AT THE ENDS OF THE STRUTS



A TRIPLE COVER OF ANY ORIENTED MESH DECOMPOSES INTO 'Z'S....

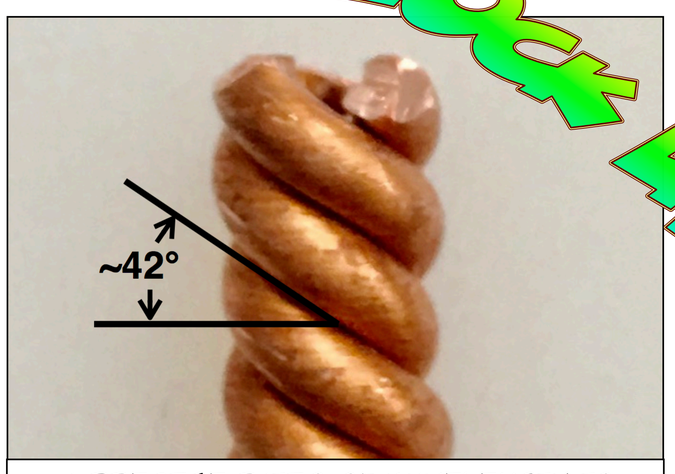


WHERE A 'Z' = CENTRAL COVER (BLACK) OF AN EDGE JOINED TO OUTBOARD COVER (GREEN) OF ITS 2 CLOCKWISE NEIGHBORS



EDGELENGTH MUST BE AN ODD NUMBER OF HELICAL HALF-WAVELENGTHS SO THE TWO BENDS CAN BE CONGRUENT

Lock up



A PRECISE RATIO OF WAVELENGTH TO STRAND DIAMETER PREVENTS A TRIPLE HELIX FROM COMPRESSING/EXTENDING

GOTCHA

BUT I HAVEN'T FOUND METALLIC WIRE THAT CAN WIND ON/OFF A LOCKED-UP TRIPLE HELIX WITHOUT DEFORMING...

...BUT UNPIGMENTED ABS FILAMENT CAN WIND ON/OFF A LOCKED UP TRIPLE HELIX IF IT HAS BEEN ANNEALED IN FINAL SHAPE

ASSEMBLED ABS TRIPLE HELICES CAN BE DYED AND ANNEALED SIMULTANEOUSLY IN BOILING WATER

References

[1] Baverel, O., "Nexorades: A Family of Interwoven Space Structures." Doctoral Thesis, University of Surrey, Dept. of Civil Eng., 2000.

[2] Mallos, J., "Unit Weave the Cubic Polyhedra." *Proceedings of ISAMA* (2009): 113-117.

[3] Benson, E., Mohammed, A., Gardell, J., Masich, S., Czeizler, E., Orponen, P. and Högberg, B. "DNA rendering of polyhedral meshes at the nanoscale." *Nature* 523, no. 7561 (2015): 441-444.

[4] Neukirch, S. and van der Heijden, G.H.M., "Geometry and mechanics of uniform n-plies: from engineering ropes to biological filaments." *Journal of elasticity,* 69, no. 1 (2002): 41-72.