1. **Research Title:** Design of Adaptive Material Networks for Sensing, Actuation and Physical Computing
2. **Individual Sponsor:**

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3. **Academic Area/Field and Education Level:** Mechanical Engineering, Applied Math, Electrical Engineering, Physics, MaterialsScience, or related field (MS or PhD}

4. **Objectives:** Develop design optimization tools, multiphysics anaylsis, and experimental model systems to leverage adaptive material nonlinearities and network behavior for sensing, actuation and physical computation.

5. **Description:** Movement and shape change are key enablers for living systems to sense, assess and respond to environmental stimuli. For example, actuating mechanisms are utilized in natural systems for diverse operations, such as arms and legs for locomotion, skin wrinkling for camouflage, or multistable snapping to catch prey. In addition, shape change and mechanical deformation of adaptive materials can also be leveraged as to source of computation, augmenting the loading bearing function of the structure to assess and pre-process state information of the local environment. Mapping these behaviors to synthetic systems is highly desirable for applications such as morphing aircraft, agile robotics and *in materio* computing, however robust design tools and adaptive material model systems are needed to interpret, program, and demonstrate these concepts. This research topic sits at the interface of soft matter responsive and adaptive materials, multiphysics computational design, and information theory/machine learning. Potential key computational challenges to address include navigation of non-convex design spaces with limited function evaluations, construction of methods that leverage all available understanding of the problem physics and search history, and novel sampling methods to leverage the mismatch in computational cost between different physics simulations. Key experimental challenges include the development adaptive materials model systems that combine diverse environmental stimuli and identify how to physically embed and read out the current state.

6. **Research Classification/Restrictions:** Unclassified and unrestricted. Eligible for Public release.

7. **Eligible Research Institutions:** All DAGSI Institutions

8. AFRL-2023-4091 Distribution A: Approved for public release; distribution unlimited.