**Component: ARMY**

**Topic #:** A20-011

**Title:** Anomalous Dispersion Enhanced Inertial Sensors

**Technology Areas:** Electronics

**ITAR:** The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 5.4.c.(8) of the Announcement and within the AF Component-specific instructions. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws. Please direct ITAR specific questions to the Army STTR Program Management Office at usarmy.rtp.aro.mail.sttr-pmo@mail.mil.

**OBJECTIVE:** Develop a prototype optical inertial navigation sensor that exploits anomalous dispersion to enhance the overall signal to noise performance of the inertial sensor.

**DESCRIPTION:** Much work has been performed in recent years on exploring the potential of utilizing anomalous dispersion to enhance the sensitivity of optically-sensed inertial navigation sensors such as Ring Laser Gyroscopes (RLGs), Passive Cavity Gyroscopes, and optically sensed accelerometers. Theoretical calculations and laboratory experiments have confirmed that sensitivities can be enhanced through the use of anomalous dispersion. While theoretical calculations have shown that it should be possible to anomalous dispersion to result in a net increase in sensor performance, in laboratory experiments to date, the attenuation in the optical signal (introduced by the absorptive media that also introduces the anomalous dispersion) has been larger than the increase in the sensitivity enhancement, resulting in a net decrease in overall inertial sensor performance. This solicitation seeks innovative approaches to this challenge to develop an optical inertial sensor design and readout architecture wherein the employment of anomalous dispersion enhancement results in laboratory and prototype demonstrations of an inertial sensor that has a net increase in the overall signal to noise. Incorporation of anomalous dispersion enhancement to optical inertial sensors has the potential to significantly increase the performance of inertial navigation systems at relatively low cost, resulting in a decreased dependence on the Global Positioning System (GPS).

**PHASE I:** In Phase I the offeror shall research and develop a theoretical model of an optically sensed inertial sensor (gyroscope or accelerometer, active or passive) whose net signal to noise ratio should increase when anomalous dispersion enhancement is introduced into the optical system. The offeror shall develop a laboratory experiment that demonstrates consistency with the theoretical predictions of the developed model including a demonstration of an increase in the overall signal to noise ratio when anomalous dispersion enhancement is introduced into the optical system.

**PHASE II:** In Phase II the offeror shall research and develop a theoretical model of an integrated prototype of the optically sensed inertial sensor (gyroscope or accelerometer, active or passive) demonstrated in Phase I. The offeror shall fabricate the prototype sensor and demonstrate that the prototype sensor demonstrates consistency with the theoretical predictions of the developed model including a demonstration of an increase in the overall signal to noise ratio when anomalous dispersion enhancement is introduced into the optical system. Potential military and commercial applications will be identified and targeted for Phase III exploitation and commercialization.

**PHASE III DUAL-USE APPLICATIONS:** The use of inertial navigation sensors is pervasive in commercial applications including automobiles, gaming consoles, and mobile phones. Successful demonstration of anomalous dispersion enhancement could lead to significant improvements in the performance of these sensors which could lead to a significantly expanded application space in both the commercial and military industries.

**REFERENCES:**


KEYWORDS: Inertial sensor, gyroscope, accelerometer, anomalous dispersion, dispersion enhancement, positioning, navigation, PNT, GPS-denied navigation.