Network Control Signaling
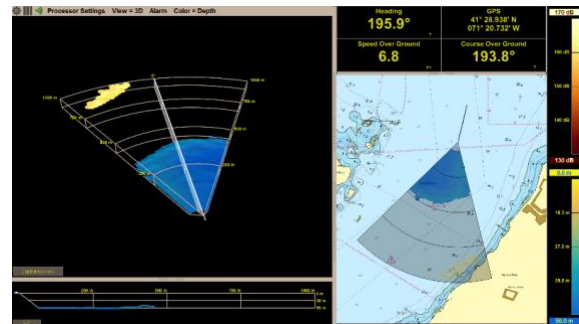
Precise Timing Control via Ethernet

ELECOMP Capstone Design Project 2020-2021

FarSounder Inc. is continuing their support of the Program, for the 2nd Year

https://web.uri.edu/elecomp-capstone/project-details-by-team/2018-2019/farsounder/

Sponsoring Company:

FarSounder, Inc.
151 Lavan St
Warwick, RI 02888
http://www.farsounder.com

Company Overview:

FarSounder, Inc. is a U.S. based marine electronics manufacturer specializing in underwater acoustics. With unique patented technology, the company has a global customer base of commercial, government, and private sector users. FarSounder is the recognized leader in real time 3D sonar systems and has been selling its flagship navigation and obstacle avoidance systems since 2004.

Technical Director:

Matthew Coolidge (URI College of Engineering Class of 2001)
Director of Hardware Development
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Project Motivation:

FarSounder 3D forward looking sonar products transmit acoustic energy and "listen" for returning echoes over an array of acoustic sensors. The received acoustic signals are digitized and processed to produce a three-dimensional representation of navigation hazards in front of the vessel.

These sonars have a transmit system that must be synchronized with the receiver's data collection system. The receiver system electronics are housed in the in-water portion of the system (the Transducer Module). The transmit system electronics are housed in the in-board portion of the system (the Power Module). A custom bundled cable (with Ethernet, transmit signal conductors, power supply conductors, and logic-level conductors) connects the two components using an expensive underwater connector at the Transducer Module. Currently, the data collection electronics drives the synchronization by using a pair of conductors (trigger signal and return) in the custom bundled cable. The current implementation requires a larger cable (more conductors), a larger underwater connector (more conductors), and limits the distance between the two components to 100 feet.

Anticipated Best Outcome:

FarSounder engineers have identified a few possible methods of replacing the logic-level trigger with an Ethernet based solution. These solutions would utilize the existing Ethernet connection inside the custom bundled cable, removing the need for the extra conductors, to signal coordinated actions between time-sensitive devices.

Project Details:

Prototype one or more of the identified Ethernet based solutions using off-the-shelf development boards and demonstrate a timing/triggering solution that meets FarSounder's current solution's capabilities using only an Ethernet connection.

Specific tasks include:

- Identify FarSounder's current system's timing requirements and limitations
- Specify the prototype solutions timing requirements
- Select the appropriate off-the-shelf development board
- Implement an Ethernet based timing/triggering solution
- Demonstrate the implemented solution meets requirements
- Produce sample source code for the development boards which could be used as a reference design by FarSounder for implementation in a future version of product electronics

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Hardware tasks include:

- Measurement of existing control signal latency and jitter
- Selection of development hardware
- Setup of development hardware to test possible solutions
- Measurement of proposed control signal latency and jitter
- Selection of appropriate Ethernet Physical interface (PHY) if necessary

Firmware tasks include:

- Configure development hardware
- Write source code for demonstrating control signaling
- Explore methods of network based control signaling including various network protocols

Composition of Team:

- 1-2 Electrical Engineers and 1 Computer Engineer

Skills Required:

Electrical Engineering Skills Required:
- Familiarity with microcontroller/microprocessor architecture
- Expertise with oscilloscope measurements
- Familiarity with network hardware including network interface controllers and switches
- Experience writing C code or similar language
- Familiarity with Version control
- Excellent verbal and written communication skills

Computer Engineering Skills Required:

- Familiarity with microcontroller/microprocessor architecture
- Expertise with oscilloscope measurements
- Familiarity with network hardware including network interface controllers and switches
- Experience writing C code or similar language
- Familiarity with Version control
- Excellent verbal and written communication skills

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

FarSounder presently fabricates a custom cable bundle where all the necessary conductors are contained within one insulating jacket. Reducing the number of conductors in the custom bundled cable will result in:

- Smaller diameter cable, which, in turn, is lighter (less costly to ship), easier to route through the vessel (due to size), and has a smaller minimum bend radius (making it more robust and easier to install).
- Reduced parts costs:
  - Lower cost cable since there are less conductors.
  - Lower cost for the underwater connector (both at the wet end of the cable and its mate on the Transducer Module) since there are less conductors.
  - A rough estimate of the total cost savings is about $300-$400 per system.
- It may also be possible to migrate to an off the shelf cable which would streamline the manufacturing process.

Additionally, logic-level signals would no longer be the primary limitation to the product's cable length. Being able to extend the cable length to 150 feet or more may also improve installation options for customers.

There is also potential savings in support costs. The present signaling system requires not only its own signaling conductors in the cable, but also isolation and interface hardware at the circuit boards at either end of the cable. These are components that could fail and render the system inoperable resulting in a costly removal at sea and customer stress.

Broader Implications of the Best Outcome on the Company's Industry:

FarSounder sonar products improve safety and provide new exploration opportunities for ocean going vessels. These improvements will improve the reliability of the product, potentially reducing service calls and downtime, as well as making the product attractive to a broader range of customers.