

SENIOR DESIGN PROJECT IN ELECTRICAL ENGINEERING

FIELD RESPONSE

EMERGENCY DEPLOYABLE

DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS) EVALUATION IN THE FIELD

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SPONSOR: USCG NAVCEN (LIAISON: LT MENDOZA)



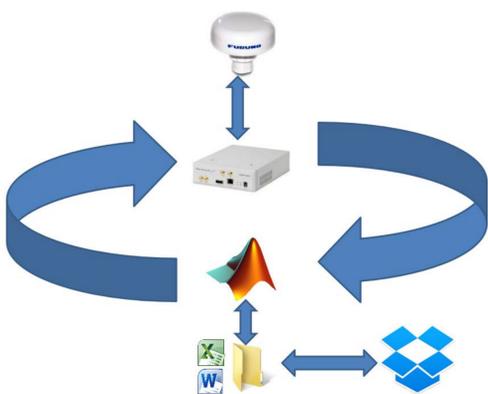
VALIDATION THAT DGPS BEACONS ARE STILL WORKING CAN BE ESSENTIAL IN THE WAKE OF NATURAL DISASTERS SUCH AS HURRICANE KATRINA.

PROJECT REQUIREMENTS

THE MAJOR REQUIREMENTS IDENTIFIED FOR THE PROJECT:

- PORTABLE SYSTEM FOR EASY DEPLOYMENT IN THE FIELD
- MULTI-CHANNEL DGPS RECEIVER CAPABILITY
- COST-EFFECTIVE COMPARED TO CURRENT-SYSTEM USED BY USCG
- USER-FRIENDLY INTERFACE
- ABLE TO LOG OUTPUT FOR FUTURE ANALYSIS

MAIN SYSTEM COMPONENTS



THE MAIN PROGRAM CONTINUOUSLY LOOPS FROM RECEIVING DATA TO THE MUCH FASTER PROCESSING MODULES. OUTPUT IS WRITTEN TO FILES THAT ARE UPDATED ONLINE IN REAL-TIME BY DROPBOX.

PROJECT BACKGROUND

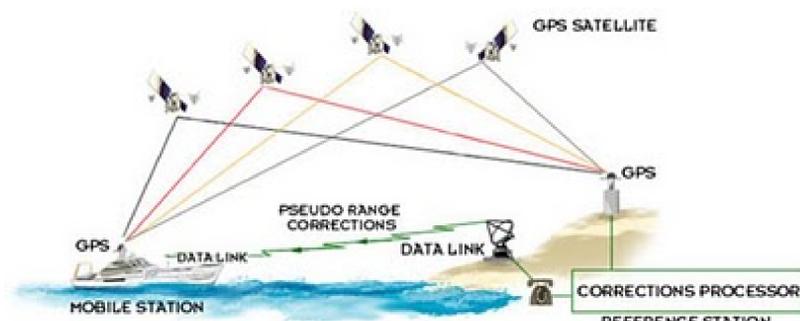
The United States Coast Guard (USCG) maintains and operates the Differential Global Positioning System (DGPS). DGPS provides multiple purposes to the public such as monitoring the health of the entire GPS constellation, providing integrity to position solutions, and also providing the increased position accuracy important for harbor and port approaches.

The current equipment that is deployed to validate the operation of DGPS Beacons is single-band, relatively costly, and cumbersome. The Field Response Emergency Deployable (FRED) project was developed to create a more efficient and cheaper system that could be easily deployed to evaluate MULTIPLE DGPS beacon signals simultaneously.

A Universal Software Radio Peripheral (USRP) is being implemented as the RF receiver for the system. The USRP is a "Software-defined radio" platform, so its operating parameters can be configured in real-time with either MATLAB or C-based software. Signal data from the USRP can be completely processed on a computer workstation, greatly simplifying operations such as filtering and demodulation.



A SOFTWARE DEFINED RADIO MODEL USRP N210 AND THE RECEIVER DAUGHTERBOARD (LFRX-LF REV 2.2) USED TO IMPLEMENT THE FRED RECEIVER.



DGPS IMPROVES THE ACCURACY OF STANDARD GPS BY BROADCASTING LOCAL CORRECTIONS TO THE GPS BROADCAST SIGNALS

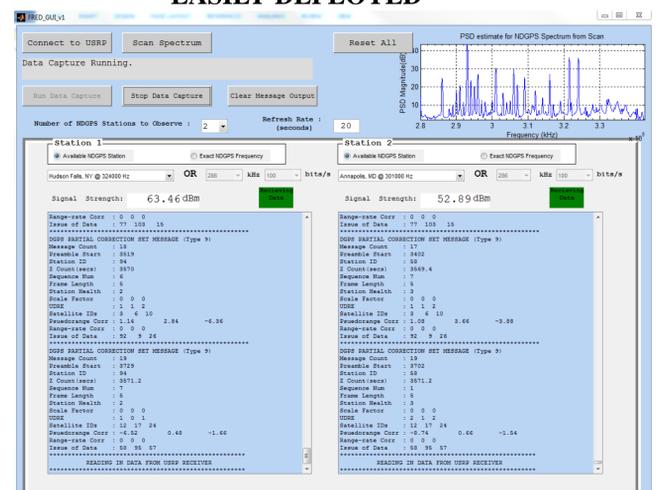
THE PROJECT RESULTS

The final FRED system consists of a USRP N210 configured to run as a DGPS Receiver. The receiver sends complex signal data to a computer running the main MATLAB program. The data is filtered, decimated, demodulated, and parsed all in software to reconstruct the DGPS message data for up to 2 stations simultaneously. Message data is displayed to the user, and logged to both text and excel files linked to Dropbox. Relative signal strength is also calculated and displayed. The program includes the ability to scan the entire DGPS spectrum for all local stations that are within range and plot the corresponding Power Spectral Density. All user interaction is through the GUI frontend. The program was designed specifically to allow expansion to more than 2 stations being received simultaneously. The FRED system can consistently receive 4-5 different beacons at a range of approximately 250 - 400 km during the day and more at night.

PROJECT DELIVERABLES

THE PROJECT GOALS ARE AS FOLLOWS:

- DESIGN DGPS RECEIVER CAPABLE OF RECEIVING ALL DGPS BEACON SIGNALS UTILIZING THE SOFTWARE-DEFINED RADIO (USRP N210)
- DEVELOP THE SOFTWARE MODULES NEEDED FOR SIGNAL PROCESSING AND PARSING
- CREATE A FRONT-END GUI THAT IS RELATIVELY SIMPLE AND USER FRIENDLY
- BE ABLE TO USE SYSTEM TO VERIFY IF LOCAL DGPS BEACONS ARE OPERATING CORRECTLY
- IMPLEMENT THE FRED SYSTEM IN A PORTABLE FORMAT THAT CAN BE EASILY DEPLOYED



THE GUI FRONT-END IS SHOWN DISPLAYING DATA FROM TWO DIFFERENT STATIONS, AND THE PARTIAL RESULTS OF A SCAN ARE VISIBLE IN THE UPPER RIGHT-HAND CORNER OF THE GUI