**SCIENTIFIC RESEARCH AND EXPERIMENTAL**

**DEVELOPMENT (SR&ED) EXPENDITURES CLAIM**

**Please do not delete, insert, or modify any rows or columns**

**As this may impact the import into Taxprep (Exception being entries in boxes 268/269)**

|  |  |
| --- | --- |
| **Client Name:** | Novatel / Hexagon |
| **Year End (YY-MM-DD):** | 2021-12-31 |
| **Prepared By:** |  |

**Part 2 – Project Information**

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| **Section A – Project Identification** | | | | | |
| **200** SR&ED Project ID (Division (if applicable)-YY-NN) and project title (60 characters maximum, including spaces) | | | | | |
|  | | Geolocation of Interferer Website Proof of Concept | | | |
| Client Project ID | | Client Project Title | | | |
|  | | G95V 2021 Research Geolocation of Interferer Website Proof of Concept | | | |
| **202** Project Start Date  (YYYY-MM-DD) | | **204** Completion or expected  completion date (YYYY-MM-DD) | |  | |
| 2021-07-04 | | 2022-09-30 | |
| **206** Field of science or technology code | | | | **208/210** Project History | |
| 2.02.09 - Software engineering and technology | | | | 210 - First claim for the project | |
| **218** Was any of the work done jointly or in collaboration with other businesses? …………………………… | | | | | NO |
|  | | | | | |
| If you answered yes to line 218, complete lines 220 and 221 | | | | | |
| **220** Names of the businesses | | | **221** Business Number (##### #### RC####) | | |
| 1 |  | |  | | |
| 2 |  | |  | | |
| 3 |  | |  | | |
| \* If business is not registered; or there is no Business number, enter NR. | | | | | |

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| **Section B – Project Descriptions** | | |
| **242** What scientific or technological uncertainties did you attempt to overcome – uncertainties that could not be removed using standard practice? (Maximum 350 words) **To be submitted to CRA with tax return** | | |
| This is a multi-year project that will implement Time-Difference of Arrival (TDOA) and Power Difference of Arrival (PDOA) algorithms in a cloud based, web-served interface. This project seeks improve the efficiency and accuracy of these techniques and extend their application.  Some NovAtel GNSS receivers can make absolute-time-tagged radio frequency (RF) measurements and output these measurements as in-phase (I) and quadrature (Q) measurements. These measurements can be combined to locate the source of RF jamming, with particular attention to jamming the occurs in or adjacent to GNSS bands. These jammer source location techniques were first developed for NovAtel MINOS6 based GNSS receivers. The extension of this capability to the new generation of MINOS7 based receivers has not been completed and part of this experimental development. This is challenging due to changes in system architecture that were introduced with the MINOS7 as well as newly supported signals and satellite constellations, which changes the behaviour of the receiver relative to the previous implementation on the OEM6.  Additionally, it is uncertain how this technique could be implemented in a cloud-computing environment, allowing for simple end-user jammer geolocation and mapping of probabilities. | **MAX** |  |
| **242 Supporting details** on scientific or technological uncertainties (**Not to be submitted to CRA with tax return)** | | |
|  | | |
| **244** What work did you perform **in the tax year** to overcome the scientific or technological uncertainties described in Line 242? (Summarize the systematic investigation or search) (Max. 700 words) **To be submitted to CRA with tax return** | | |
| During the 2021 tax year the following work was completed:   * Reviewed existing OEM6 TDOA and PDOA research and data. Assessed the data for the suitability to test on an implemented, cloud-based geolocation service. * Collected additional data using the new OEM7 platform with the following parameters  1. Search for suspected jammers (based on jamming like events observed during operation of competitive GNSS receivers) 2. Collection of long duration GNSS signals (> 4 hours) in signal environments where jammers are likely to exist in the form of personal privacy devices. These environments include high vehicle traffic corridors such as highways. 3. Collection of RF signals in known jammer environments, where a jammer is intentionally broadcast in non-protected bands but within the bandwidth of the GNSS receiver.  * Processed data using TDOA and PDOA techniques to determine the accuracy and precision of the location methodologies in determination of the jammer location. * Investigated ways to improve algorithms for jammer location estimate (both in accuracy and processing time). Standard techniques for grid-based search of probable likelihood of power difference of arrival sources are exhaustive. Reduction of the search space is possible with additional constraints. * Explored the factors the affect the quality of the estimated jammer location. | **MAX** |  |
| **244 Supporting details** on work performed in tax year (**Not to be submitted to CRA with tax return)** | | |
|  | | |
| **246** What scientific or technological advancements did you achieve as a result of the work described in Line 244? (Maximum 350 words) **To be submitted to CRA with tax return** | | |
| The work described in 244 resulted in the following advancements:   * Improved TDOA method using OEM7/MINOS7 measurements to estimate a jammer location. * An improved algorithm for grid-based spatial search. * Preliminary cloud-based implementation of the processing capability. | **MAX** |  |
| **246** **Supporting details** on scientific or technological advancements (**Not to be submitted to CRA with tax return)** | | |
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| **Section C – Additional Project Information** | | | | | | | | | | | | | |
| Who prepared the responses for Section B? | | | | | | | | | | | | | |
| **253**  Employee directly involved in the project | | | | | **254** Name | |  | | | | | | |
| **255**  Other employee of the company | | | | | **256** Name | | Joshua Houghton | | | | | | |
| **257**  External consultant | | | | | **258** Name | | KPMG LLP | | | **259** Firm | | | KPMG LLP |
| List the key individuals directly involved in the project and indicate their qualifications/experience | | | | | | | | | | | | | |
| **260** Names | | | **261** Qualifications/experience and position title | | | | | | | | | | |
| 1 | Edmond Leahy | | B.Sc. Geomatics Engineering, Verification Designer | | | | | | | | | | |
| 2 | Sandy Kennedy | | M.Sc. Geomatics Engineering, VP Innovation | | | | | | | | | | |
| 3 | Jon Jacox | | B. Eng Computer Engineering, Research Engineer | | | | | | | | | | |
| **265** Are you claiming any salary or wages for SR&ED performed outside Canada? | | | | | | | | | | | | NO | |
| **266** Are you claiming expenditures for SR&ED carried out on behalf of another party? | | | | | | | | | | | | NO | |
| **267** Are you claiming expenditures for SR&ED performed by people other than your employees? | | | | | | | | | | | | NO | |
| If you answered **yes** to line 267, complete lines 268 and 269 | | | | | | | | | | | | | |
| **268** Names of the businesses | | | | | | **269** Business Number (##### #### RC####) | | | | | | | |
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| What evidence do you have to support your claim? (Check any that apply)  You do not need to submit the evidence with the claim. However, you are required to retain them in the event of a review. | | | | | | | | | | | | | |
| **270**  Project planning documents | | | | | **276**  Progress reports, minutes of project meetings | | | | | | | | |
| **271**  Records of resources allocated to the project, time sheets | | | | | **277**  Test protocols, test data, analysis of test results, conclusions | | | | | | | | |
| **272**  Design of experiments | | | | | **278**  Photographs and videos | | | | | | | | |
| **273**  Project records, laboratory notebooks | | | | | **279**  Samples, prototypes, scrap or other artifacts | | | | | | | | |
| **274**  Design, system architecture and source code | | | | | **280**  Contracts | | | | | | | | |
| **275**  Records of trial runs | | | | | **281**  Others, specify | | | **282** | | |  | | |
| Reviewed by: | |  | | Finalized: | | | | |  | | | | |
|  | | | | | | | | | | | | | |