CIC IoV Dataset 2024

**CICIoV2024: A Benchmark CAN Dataset to Evaluate IoV Security Solutions**

The main goal of this research is to propose a realistic benchmark dataset to support the development of new cybersecurity solutions for IoV operations. To accomplish this, five attacks were executed against the fully intact inner structure of a 2019 Ford car, complete with all ECUs (Electronic Control Units). However, the vehicle was rendered immobile and incapable of causing any potential harm or injuries. Hence, all attacks were carried out on the vehicle without endangering the car's driver or passengers.

These attacks are classified as spoofing and Denial-of-Service (Dos) and were carried out through the CAN-BUS protocol. This effort establishes a baseline complementary to existing contributions and supports researchers to propose new IoV solutions to strengthen the overall security using different techniques (e.g., Machine Learning - ML).

The main contributions are:

* A
* B
* C

A diagram of a car

Description automatically generated

A close-up of a computer

Description automatically generated

## **Data Description**

Decimal Representation:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **mean** | **std** | **min** | **25%** | **50%** | **75%** | **max** |
| **ID** | 537.207946 | 322.479994 | 65 | 357 | 516 | 578 | 1438 |
| **DATA\_0** | 71.0865995 | 88.9771748 | 0 | 0 | 16 | 127 | 255 |
| **DATA\_1** | 69.9892503 | 95.5837431 | 0 | 0 | 12 | 128 | 255 |
| **DATA\_2** | 55.0112724 | 72.7658378 | 0 | 0 | 13 | 125 | 255 |
| **DATA\_3** | 57.4536383 | 90.3207664 | 0 | 0 | 0 | 92 | 255 |
| **DATA\_4** | 45.2851673 | 64.4583498 | 0 | 0 | 6 | 86 | 255 |
| **DATA\_5** | 53.8826134 | 94.3361202 | 0 | 0 | 0 | 63 | 255 |
| **DATA\_6** | 71.7491441 | 101.687183 | 0 | 0 | 0 | 138 | 255 |
| **DATA\_7** | 60.2747691 | 99.9654672 | 0 | 0 | 0 | 80 | 255 |

Binary Representation:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **mean** | **std** | **min** | **25%** | **50%** | **75%** | **max** |
| **ID0** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ID1** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ID2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ID3** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ID4** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ID5** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **ID6** | 0.16952406 | 0.37521428 | 0 | 0 | 0 | 0 | 1 |
| **ID7** | 0.42718498 | 0.49466973 | 0 | 0 | 0 | 1 | 1 |
| **ID8** | 0.29153065 | 0.45446747 | 0 | 0 | 0 | 1 | 1 |
| **ID9** | 0.13162299 | 0.33808056 | 0 | 0 | 0 | 0 | 1 |
| **ID10** | 0.37840989 | 0.48499074 | 0 | 0 | 0 | 1 | 1 |
| **ID11** | 0.50427242 | 0.49998192 | 0 | 0 | 1 | 1 | 1 |
| **ID12** | 0.48455602 | 0.4997616 | 0 | 0 | 0 | 1 | 1 |
| **ID13** | 0.19254321 | 0.39429739 | 0 | 0 | 0 | 0 | 1 |
| **ID14** | 0.5746173 | 0.49440108 | 0 | 0 | 1 | 1 | 1 |
| **ID15** | 0.46847259 | 0.49900521 | 0 | 0 | 0 | 1 | 1 |
| **ID16** | 0.53340638 | 0.49888294 | 0 | 0 | 1 | 1 | 1 |
| **DATA\_00** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_01** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_02** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_03** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_04** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_05** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_06** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_07** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_08** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_09** | 0.22309243 | 0.41631998 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_010** | 0.34454158 | 0.47521873 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_011** | 0.31769774 | 0.4655814 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_012** | 0.33472706 | 0.47189513 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_013** | 0.31426362 | 0.46422209 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_014** | 0.37693711 | 0.48461912 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_015** | 0.32008942 | 0.46651081 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_016** | 0.29611019 | 0.45654035 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_10** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_11** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_12** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_13** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_14** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_15** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_16** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_17** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_18** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_19** | 0.28475827 | 0.45129939 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_110** | 0.24356439 | 0.42923293 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_111** | 0.28651083 | 0.45213109 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_112** | 0.24899749 | 0.43243251 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_113** | 0.31631799 | 0.46503879 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_114** | 0.35077854 | 0.47721391 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_115** | 0.28126236 | 0.44961538 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_116** | 0.30358204 | 0.45980445 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_20** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_21** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_22** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_23** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_24** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_25** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_26** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_27** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_28** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_29** | 0.16682206 | 0.37281706 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_210** | 0.23185811 | 0.42201902 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_211** | 0.30791589 | 0.46163172 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_212** | 0.25489004 | 0.43579955 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_213** | 0.33766694 | 0.47291451 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_214** | 0.30989072 | 0.4624485 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_215** | 0.30772841 | 0.46155367 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_216** | 0.33122476 | 0.47065388 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_30** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_31** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_32** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_33** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_34** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_35** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_36** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_37** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_38** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_39** | 0.1918338 | 0.39374319 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_310** | 0.25849389 | 0.43780696 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_311** | 0.23691912 | 0.4251924 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_312** | 0.29121678 | 0.45432336 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_313** | 0.2679498 | 0.44289146 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_314** | 0.29034333 | 0.45392095 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_315** | 0.26623629 | 0.44198944 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_316** | 0.27697894 | 0.44750614 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_40** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_41** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_42** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_43** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_44** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_45** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_46** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_47** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_48** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_49** | 0.11576182 | 0.31993921 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_410** | 0.25658935 | 0.43675095 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_411** | 0.18494851 | 0.38825593 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_412** | 0.23620332 | 0.42474868 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_413** | 0.2521845 | 0.43426675 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_414** | 0.30246503 | 0.45932569 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_415** | 0.40185582 | 0.49027328 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_416** | 0.31728233 | 0.46541853 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_50** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_51** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_52** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_53** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_54** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_55** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_56** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_57** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_58** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_59** | 0.17389412 | 0.37901854 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_510** | 0.24749915 | 0.43155933 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_511** | 0.22956799 | 0.42055517 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_512** | 0.22830185 | 0.4197383 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_513** | 0.30647222 | 0.46102836 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_514** | 0.31337526 | 0.46386567 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_515** | 0.33985907 | 0.47366132 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_516** | 0.400219 | 0.48994278 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_60** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_61** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_62** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_63** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_64** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_65** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_66** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_67** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_68** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_69** | 0.26563695 | 0.44167194 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_610** | 0.29937602 | 0.4579849 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_611** | 0.32685967 | 0.46906565 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_612** | 0.24077505 | 0.42755416 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_613** | 0.28923981 | 0.45340963 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_614** | 0.23674372 | 0.42508382 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_615** | 0.35568971 | 0.47872195 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_616** | 0.30336617 | 0.45971218 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_70** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_71** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_72** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_73** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_74** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_75** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_76** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_77** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_78** | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **DATA\_79** | 0.22083781 | 0.41481152 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_710** | 0.25788674 | 0.43747149 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_711** | 0.25140266 | 0.43381966 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_712** | 0.25464434 | 0.43566126 | 0 | 0 | 0 | 1 | 1 |
| **DATA\_713** | 0.22435147 | 0.41715466 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_714** | 0.22010852 | 0.41431978 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_715** | 0.23915456 | 0.42656745 | 0 | 0 | 0 | 0 | 1 |
| **DATA\_716** | 0.23002885 | 0.42085117 | 0 | 0 | 0 | 0 | 1 |

A screenshot of a graph

Description automatically generated

## **Dataset Directories**

The main dataset directory (CICIoV2024) contains four subdirectories related to different files, namely:

**Hexadecimal:** Data collected represented in **hexadecimal** format (benign, DoS, spoofing-GAS, spoofing-RPM, spoofing-SPEED, and spoofing-STEERING\_WHEEL).

**Decimal:** Data collected represented in **decimal** format (benign, DoS, spoofing-GAS, spoofing-RPM, spoofing-SPEED, and spoofing-STEERING\_WHEEL).

**Binary:** Data collected represented in **binary** format (benign, DoS, spoofing-GAS, spoofing-RPM, spoofing-SPEED, and spoofing-STEERING\_WHEEL).

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## **Citation**

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