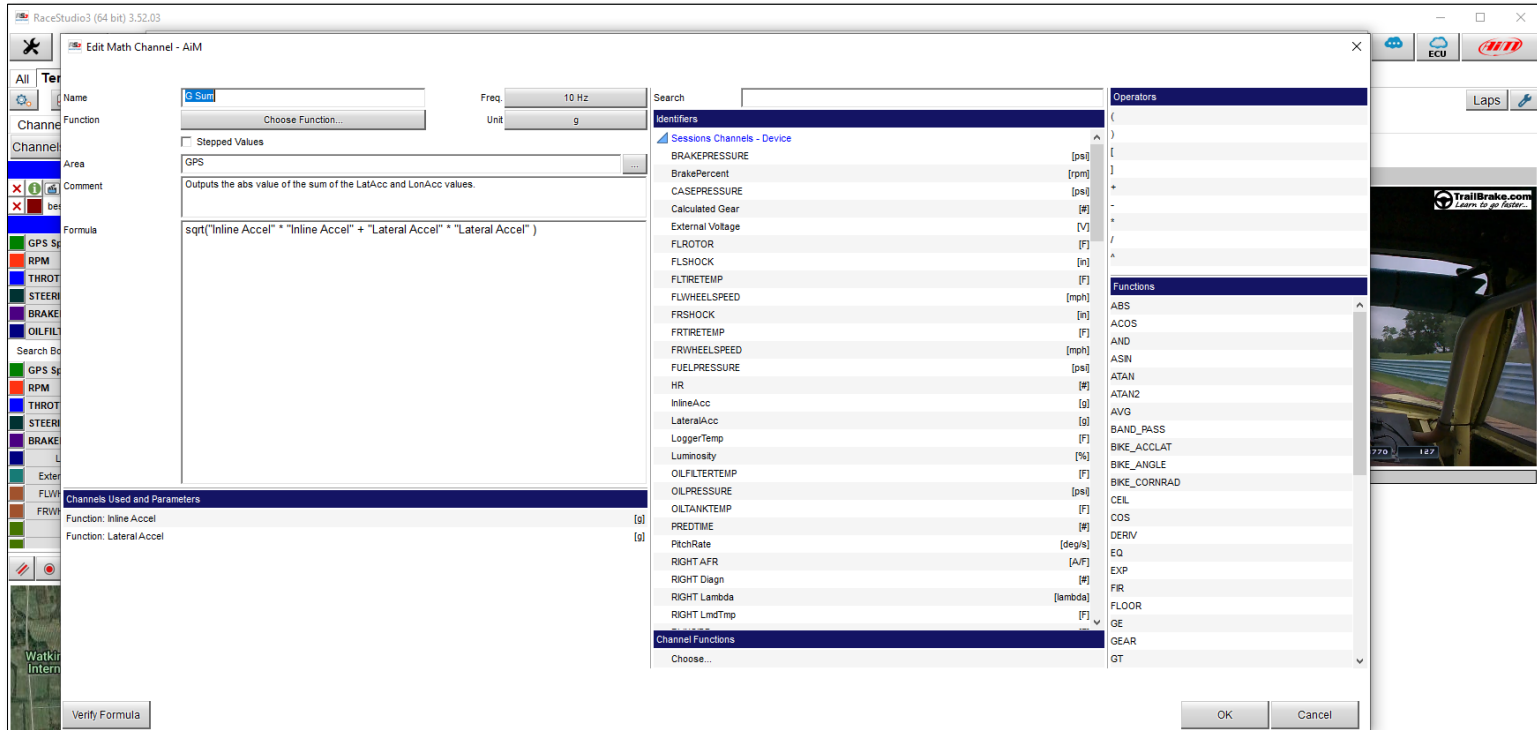


RS3 Math Channel Function

A New and More Powerful Tool



Host:

Roger Caddell

AiM Sports - National Training Manager

Co-Host:

Emiliano Bina

AiM-Sportline - Software Team



aimsports.com

Tuesday March 15th, 2022

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RS3
RACESTUDIO

- Graduated in 2000 as Road Vehicles Engineer with a Thesis on a Simulation Model for Toyota Prius Hybrid Powertrain
- Software Developer for AiM Since 2000: RaceStudio2 Analysis, DragAnalyzer, GPSManager, RaceStudio3
- Passion for Sim Racing and Motorsport, Cooperated for Data Analysis in Endurance Races
- 13 Time AiM Sports Webinar Co-Host!



Emiliano Bina

AiM-Sportline Software Developer

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Math Channels - Application

The idea is to create your own set, made of many subsets, that we call “Areas”.

You can export/import sets, to share them with friends or colleagues.

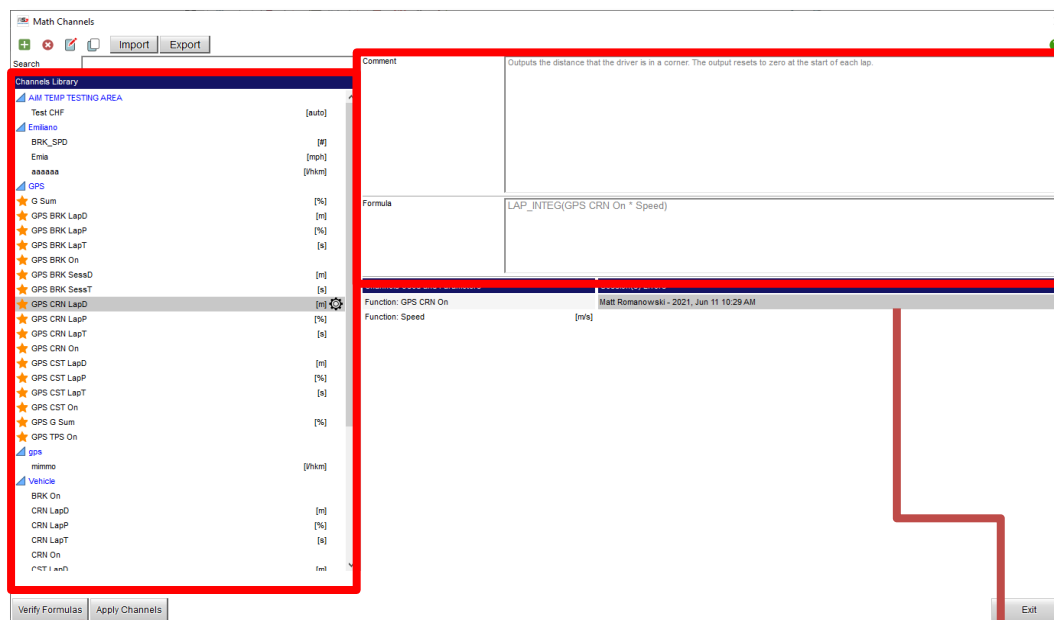
You can import channels from RS2A. They will be converted in the RS3 format.

Math channels are computed only when created or modified, differently from RS2A that used to compute their values every time you open the session.

This allows you to enable a lot of them and leaving them ‘ON’, without having the RS3 slow down when you open a session for analysis.

Another item of difference from RS2A is that there’s always, in RS3, at least one open session while using the math channels windows.

Math Channels - Application

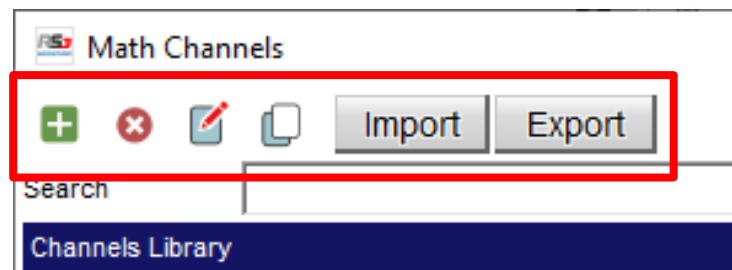


All your Math Channels, grouped in Areas.
Comment and Formula, for a quick glance at the selected channel.

Simply choose which channels you want to enable.

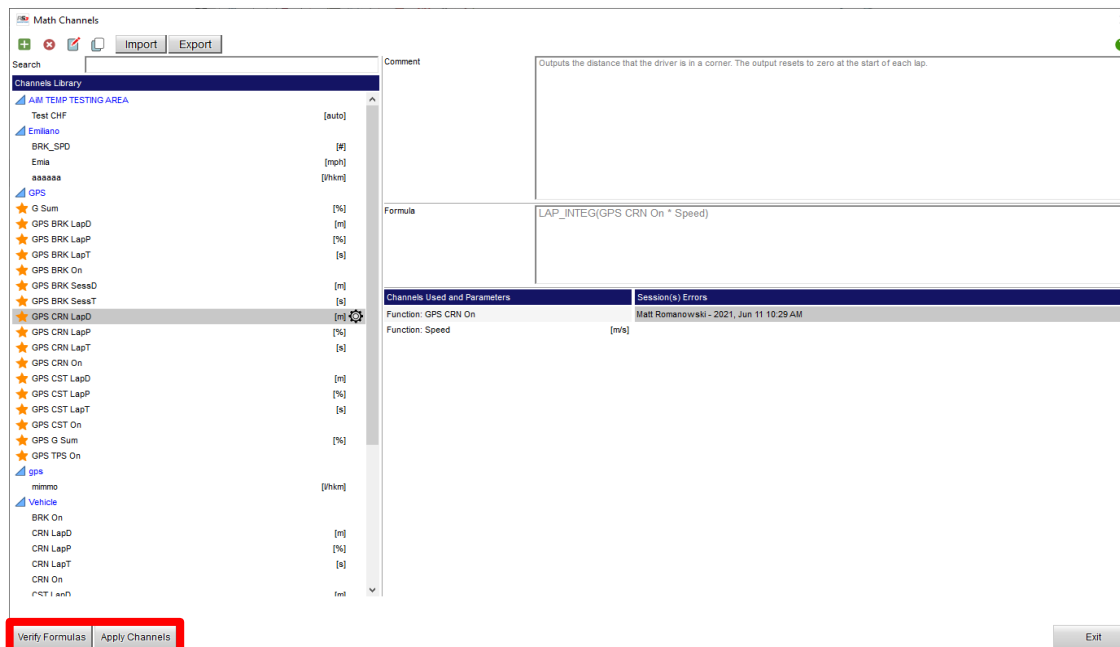
Choose if to enable them for all sessions or if you prefer to enable them only for a specific logger.

Math Channels - Application



- “Add”, adds a new channel;
- “Delete”, deletes the selected one;
- “Edit”, edits the selected one;
- “Clone”, clones the selected one;
- “Import”, lets you import new previously saved channels (differently from RS2A it keeps adding channels, instead of substituting) either from RS3 or from RS2;
- “Export”, lets you export one channel, one area or all your channels into a file;

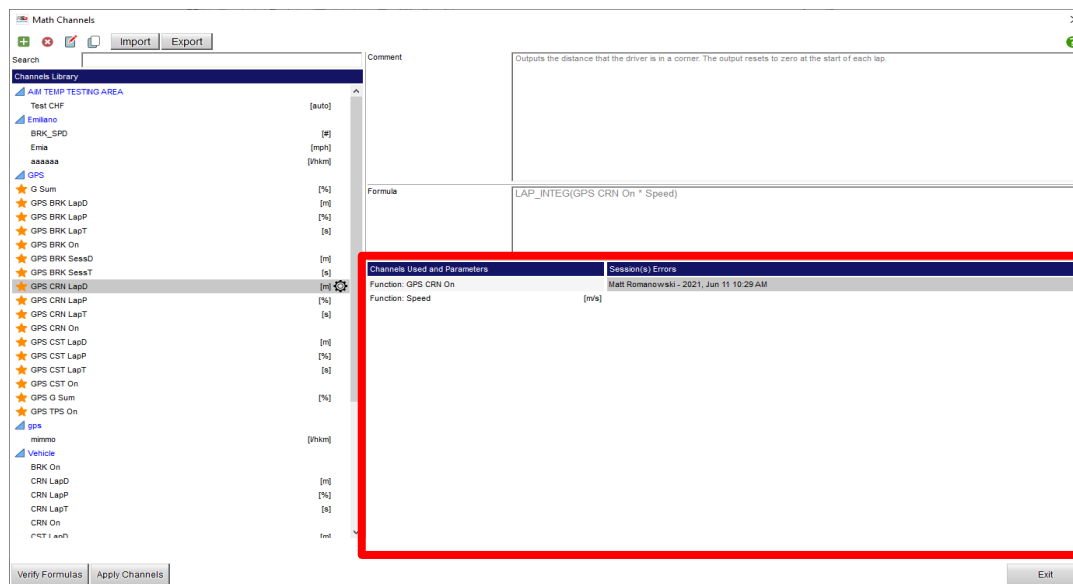
Math Channels - Application



“Verify Formulas” allows you to doublecheck the enabled channels with the selected session.
“Apply Channels” inserts channels into the session.

There’s always a ‘loaded’ session:
either the selected session(s) in the DB window
or the session(s) open for analysis.

Math Channels - Application



When you select a set of channels, they get inserted into the sessions. In the highlighted area RS3 shows potential problems in channel computation.

There's no need to sort the channels as RS3 creates a computation cycle that iterates the computations and solves cross references between channels.

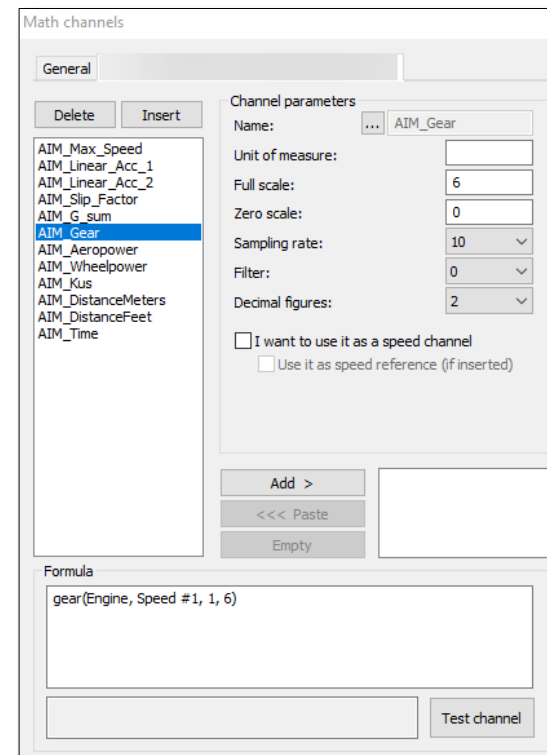
RS3 cannot solve loops within channels, i.e., channel "A" that uses channel "B" that uses channel "C" that uses channel "A".

Math Channels - Application

Soon here...

All the channels of the RS2A default math channels set;

Improvements in the errors that are shown, to better guide users in identifying where a problem could hide.





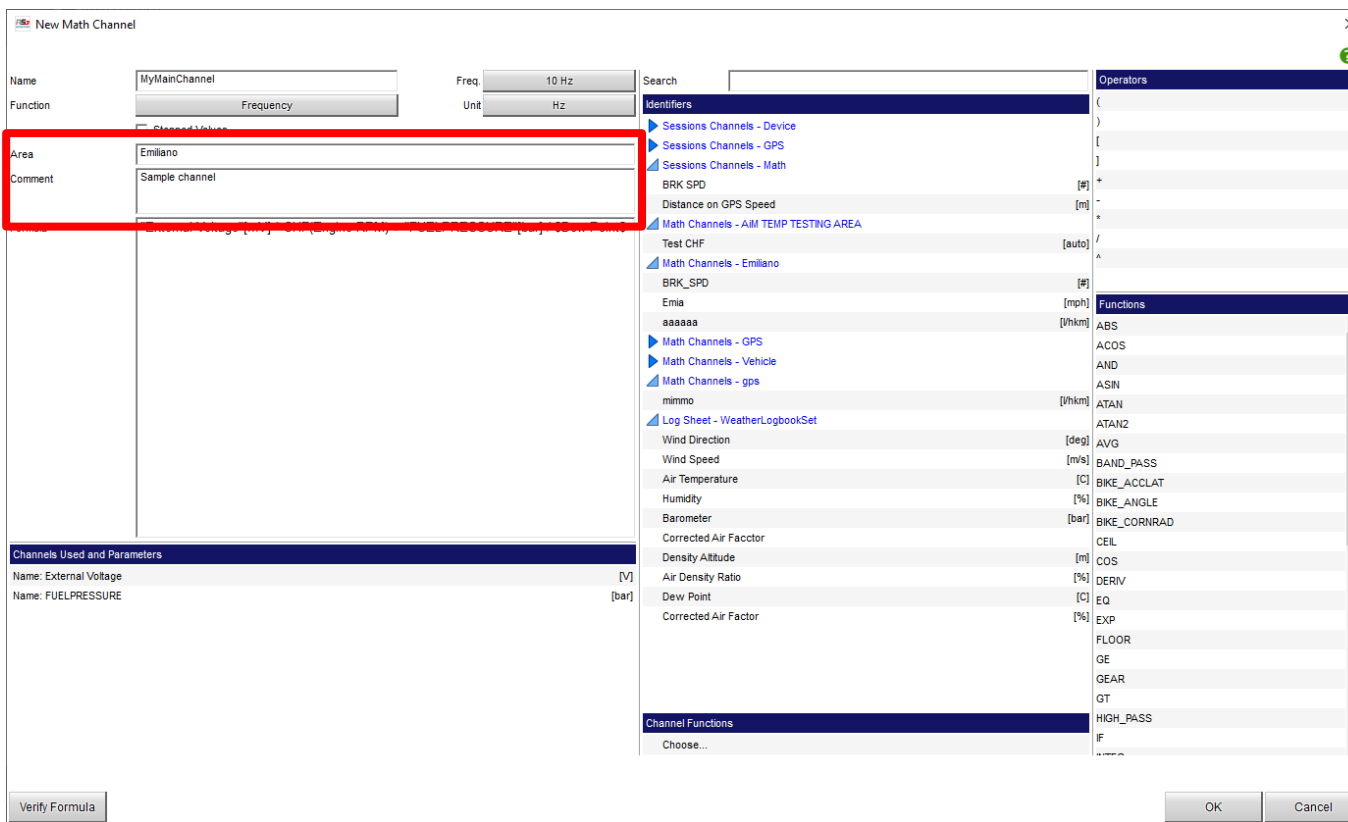
Math Channels – Creation/Edit

The idea is to create the channel(s) that will be available in the math channels application window.

When you verify the formula, you're matching its syntax against the channels of the loaded session(s).

Math Channels – Creation (Area/Comment)

Remember to use the “Area” and “Comment” fields to help identifying the channel and selecting it correctly in the math channels application window.



New Math Channel

Name: MyMainChannel Freq: 10 Hz Search: Operators: (?

Function: Frequency Unit: Hz

Area: Emiliano

Comment: Sample channel

Channels Used and Parameters

Name	Unit
External Voltage	[V]
FUELPRESSURE	[bar]

Identifiers

- Sessions Channels - Device
- Sessions Channels - GPS
- Sessions Channels - Math
- BRK SPD
- Distance on GPS Speed
- Math Channels - AM TEMP TESTING AREA
- Test CHF
- Math Channels - Emiliano
- BRK_SPD
- Emia
- aaaaaa
- Math Channels - GPS
- Math Channels - Vehicle
- Math Channels - gps
- mimmo
- Log Sheet - WeatherLogbookSet
- Wind Direction
- Wind Speed
- Air Temperature
- Humidity
- Barometer
- Corrected Air Factor
- Density Altitude
- Air Density Ratio
- Dew Point
- Corrected Air Factor

Functions

- ABS
- ACOS
- AND
- ASIN
- ATAN
- ATAN2
- AVG
- BAND_PASS
- BIKE_ACCLAT
- BIKE_ANGLE
- BIKE_CORNRAD
- CEL
- COS
- DERIV
- EQ
- EXP
- FLOOR
- GE
- GEAR
- GT
- HIGH_PASS
- IF

Channel Functions

Choose...

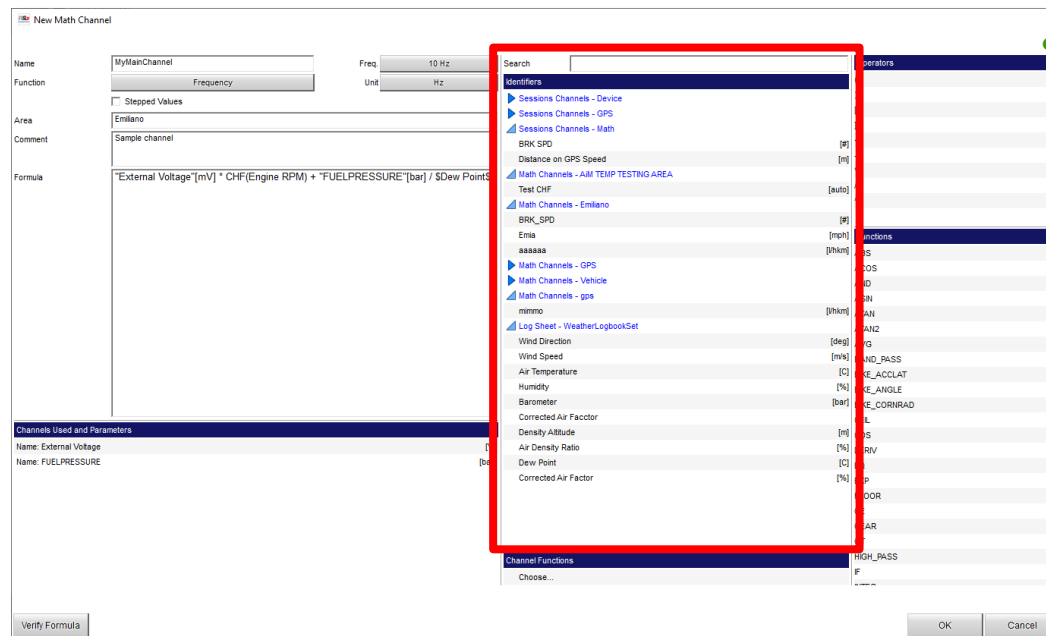
Verify Formula OK Cancel

Math Channels – Creation (Identifiers)



Identifiers come from:

- Channels of the loaded sessions
- Other math channels
- Log Sheets



Math Channels – Creation (Operators/Functions)



Same operators of RS2A.
Some more functions.

New Math Channel

Name: MyMainChannel
Function: Frequency
Area: Emiliano
Comment: Sample channel
Formula: "External Voltage"[mV] * CHF(Engine RPM) + "FUELPRESSURE"[bar] / \$Dew Point\$

Channels Used and Parameters

Name: External Voltage [V]
Name: FUELPRESSURE [bar]

Operators

- (
-)
- [
-]
- +
-
- *
- /
- ^
- %
- sqrt
- abs
- sin
- cos
- tan
- atan
- atan2
- avg
- band_pass
- band_acclat
- bike_angle
- bike_cornrad
- ceil
- cos
- deriv
- eq
- exp
- floor
- ge
- gear
- gt
- high_pass
- if

Functions

- ABS
- ACOS
- AND
- ASIN
- ATAN
- ATAN2
- AVG
- BAND_PASS
- BIKE_ACCLAT
- BIKE_ANGLE
- BIKE_CORNRAD
- CEIL
- COS
- DERIV
- EQ
- EXP
- FLOOR
- GE
- GEAR
- GT
- HIGH_PASS
- IF

Channel Functions

Choose...

Verify Formula

OK Cancel

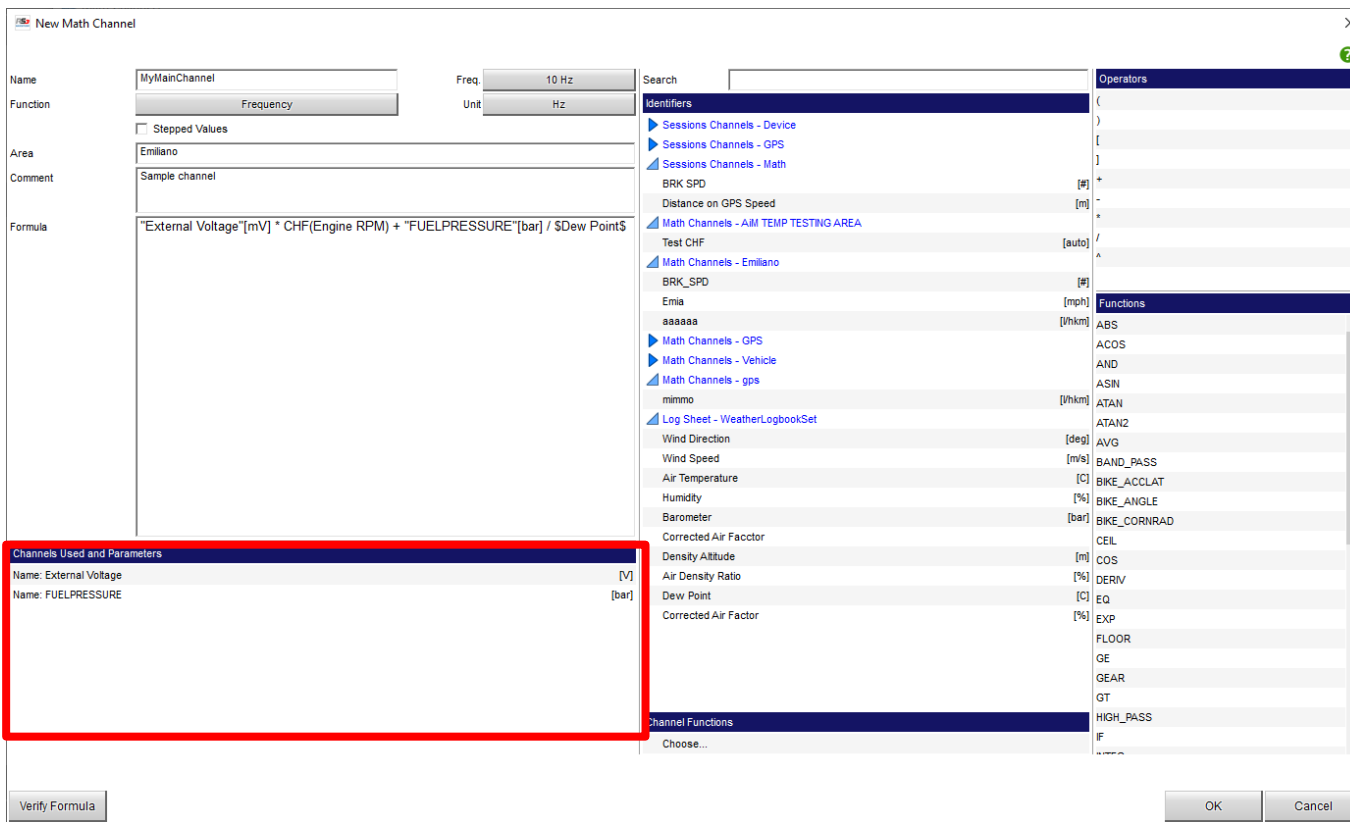
Math Channels – Creation (Operators/Functions)

What has been added:

- Time Shift: **TIME_SHIFT** function, to which you pass the channel to be shifted and the shift value, in seconds
- Filters:
 - **FIR** function, to which you pass a number from 1 to 3, representing the strength of the filter
 - **ROLL_AVG** function, to which you pass a number from 3 to 10, representing the number of samples that are averaged
- Intuitive operators for greater or lower: you can now use '>' and '<'

Math Channels – Creation (Verification Results)

In the bottom left part of the window, you can get the result of channel verification, right after having clicked the “Verify Formula” button.



New Math Channel

Name: MyMainChannel
Function: Frequency
Area: Emiliano
Comment: Sample channel
Formula: "External Voltage"[mV] * CHF(Engine RPM) + "FUELPRESSURE"[bar] / \$Dew Point\$

Channels Used and Parameters

Name	Unit
External Voltage	[mV]
FUELPRESSURE	[bar]

Identifiers

- Sessions Channels - Device
- Sessions Channels - GPS
- Sessions Channels - Math
- BRK SPD
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- CEL
- COS
- DERIV
- EQ
- EXP
- FLOOR
- GE
- GEAR
- GT
- HIGH_PASS
- IF

Channel Functions

Choose...

Verify Formula

OK Cancel

Math Channels – Creation (Formula)



The “Formula” field is or, better, can be a little more complicated, if compared with RS2A

New Math Channel

Name: MyMainChannel Freq: 10 Hz Unit: Hz

Function: Frequency

Area: Emiliano

Comment: Sample channel

Formula: "External Voltage"[mV] * CHF(Engine RPM) + "FUELPRESSURE"[bar] / \$Dew Point\$

Channels Used and Parameters

Name: External Voltage [V]

Name: FUELPRESSURE [bar]

Identifiers

- Sessions Channels - Device
- Sessions Channels - GPS
- Sessions Channels - Math
- BRK SPD
- Distance on GPS Speed
- Math Channels - AM TEMP TESTING AREA
- Test CHF
- Math Channels - Emiliano
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- Air Density Ratio
- Dew Point
- Corrected Air Factor

Operators

- (
-)
- [
-]
- +
-
- *
- /
- ^

Functions

- ABS
- ACOS
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- BIKE_CORNRAD
- CEL
- COS
- DERIV
- EQ
- EXP
- FLOOR
- GE
- GEAR
- GT
- HIGH_PASS
- IF

Channel Functions

Choose...

Verify Formula

OK Cancel

Math Channels – Formula Syntax

Use of identifiers

- Channel names, surround the channel name with quotation marks, example: “RPM”, “GPS Speed”...
- Channels, referenced by functions, CHF(Engine RPM). CHF stays for **CH**annel **F**unction. You need to insert the exact AiM function name, you can be eased into this using the “Choose Function” button (center bottom of the window).
- Log Sheets items, surround the item name with the dollar char, example: \$Dew Point\$, \$Humidity\$.

These formats are applied automatically when double clicking the identifiers.
Surrounding chars allow the presence of spaces in identifier names.

Units

In case you want an identifier to be used always with the same units of measure, just add the units you want aside the identifier name, example: “GPS Speed”[mph] * 2

If you export this channel, and you give it to a friend that uses km/h, well

- His GPS Speed channel will be displayed in km/h;
- The math channel you give him will be always converting his speed into mph for its calculations;
- He will be able to choose the units in which he will display his math channel, according to the units available for the AiM function you choose for the channel.

Math Channels – Creation (CHannel FFunction)



You can refer your formula to a channel, choosing it by its function instead that by its name. Our advice is to use our helper.

New Math Channel

Name: MyMainChannel
Function: Frequency
Area: Emiliano
Comment: Sample channel
Formula: "External Voltage"[mV] * CHF(Engine RPM) + "FUELPRESSURE"[bar] / \$Dew Point\$

Channels Used and Parameters

Name: External Voltage [V]
Name: FUELPRESSURE [bar]

Channel Functions
Choose...

Math Channels – Creation (LookUp Tables)

Soon here... you'll be able to define your own curves.

Nome: GPS BRK Sessid

Funzione: Scegli la Funzione...

Area: GPS

Comment: Outputs distance covered when the driver was on the brakes. Starts each session from zero and counts up for the entire session

Formula: INTEG("GPS BRK On""GPS Speed"[m/s])

Canali Utilizzati e Parametri

LookUp Tables

Math Channels – Creation (LookUp Tables)



```

1
2 X, "mph", "SPEED", 6
3 Y, "lbf", "FORCE"
4 I, INTERP
5 BEGIN_TABLE
6 V, 10.0, 100.0
7 V, 30.0, 150.0
8 V, 50.0, 210.0
9 V, 70.0, 290.0
10 V, 90.0, 370.0
11 V, 110.0, 510.0
12 END_TABLE
13

```

2D tables

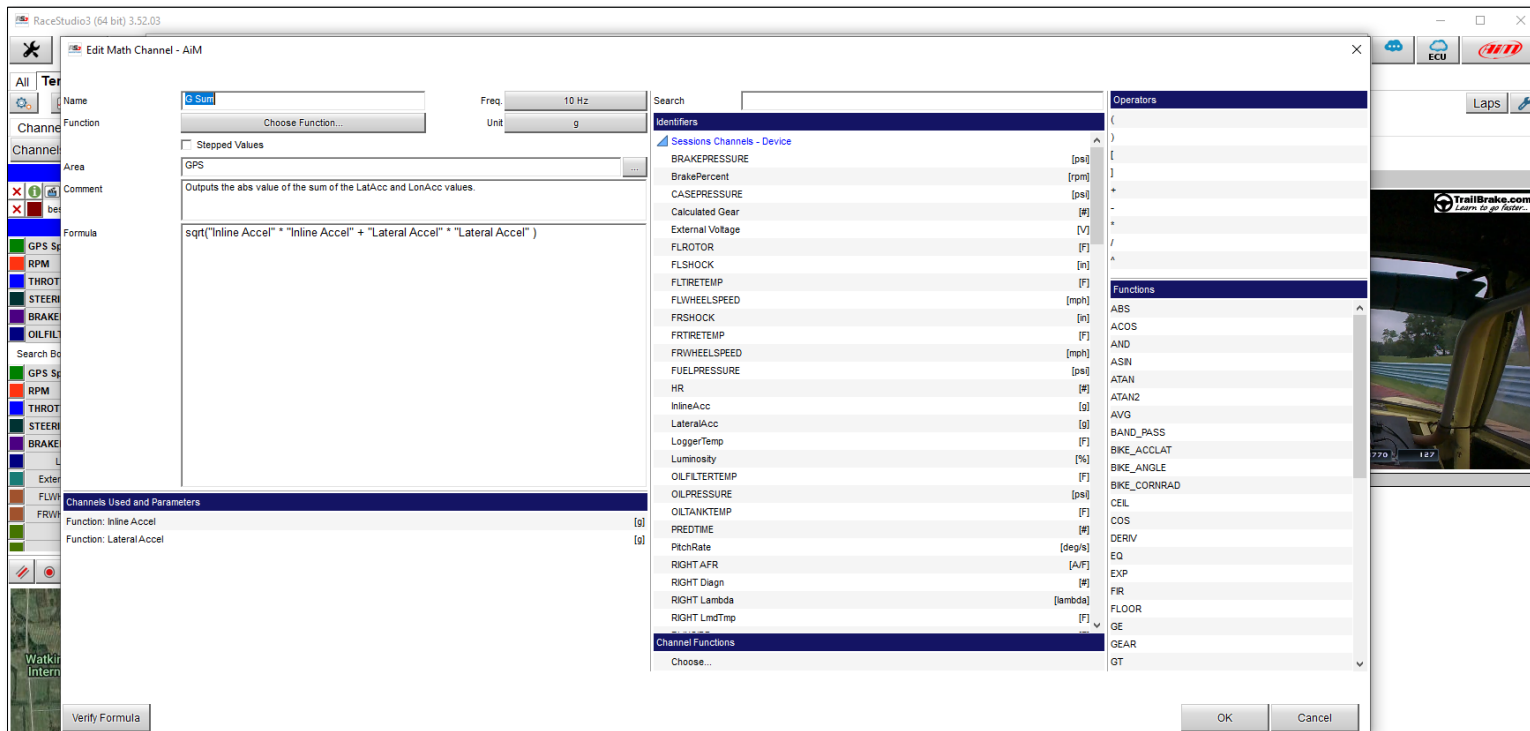
3D tables

```

1
2 X, "rpm", "RPM", 6
3 Y, "%", "PERCENT", COL_NPOINTS
4 Z, "lambda", "LAMBDA"
5 I, INTERP
6 BEGIN_TABLE
7 V, *, 0.0, 20.0, 40.0, 60.0, 80.0, 100.0
8 V, 1000.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0
9 V, 2000.0, 0.1, 0.1, 0.1, 0.1, 0.2, 0.2
10 V, 3000.0, 0.2, 0.2, 0.3, 0.3, 0.4, 0.4
11 V, 4000.0, 0.3, 0.4, 0.6, 0.5, 0.6, 0.7
12 V, 5000.0, 0.4, 0.5, 0.7, 0.7, 0.9, 0.7
13 V, 6000.0, 0.5, 0.6, 0.7, 0.8, 0.9, 0.9
14 END_TABLE
15

```

Live RS3A Demonstration



Race Studio 3 – Math Channels

Live RS3A Demonstration

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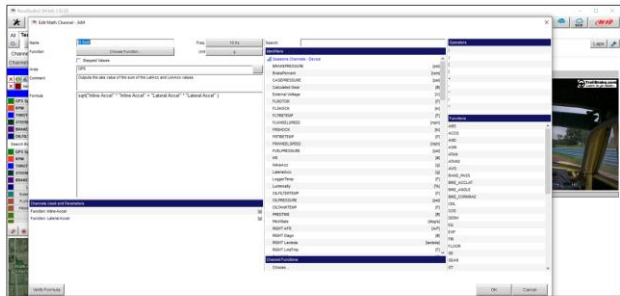
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RS3 Math Channel Function
A New and More Powerful Tool



Host:
Roger Caddell
AIM Sports - National Training Manager

Co-Host:
Emiliano Bina
AIM-Sportline - Software Team

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 - Measure Units
 - Sort Channels
 - Test Properties
 - Per Lap Color
 - Export Tests
 - Channel Reports
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 - Sensor Calibration
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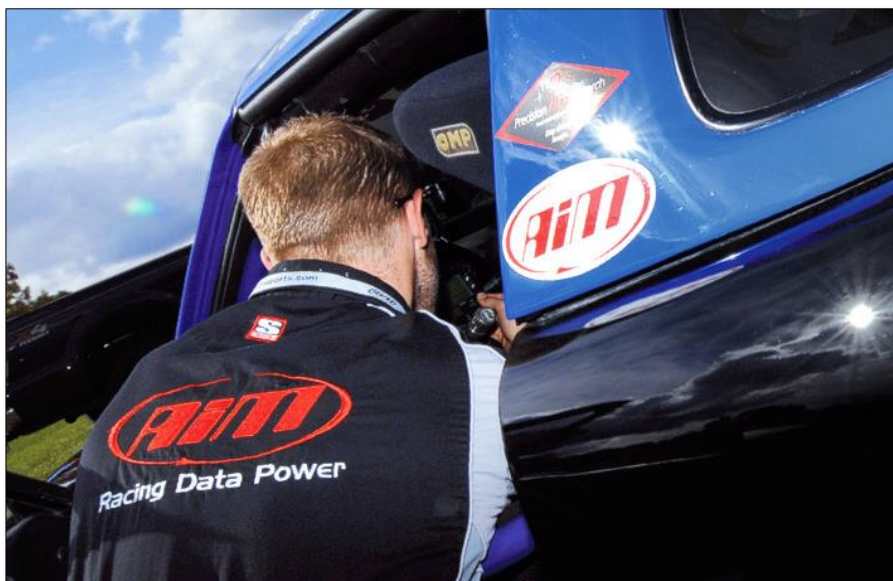
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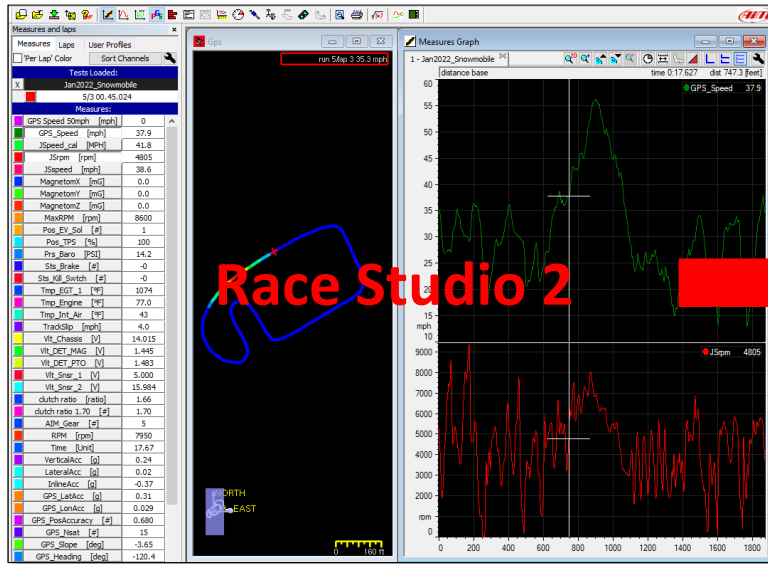
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RS2 Analysis to RS3 Analysis

Tips & Tricks to Get You Started Right



Host:

Roger Caddell

AIM Sports - National Training Manager

Next Webinar: Tuesday March 22nd, 2022 - 10:00am Pac/1:00pm East

Next Webinar

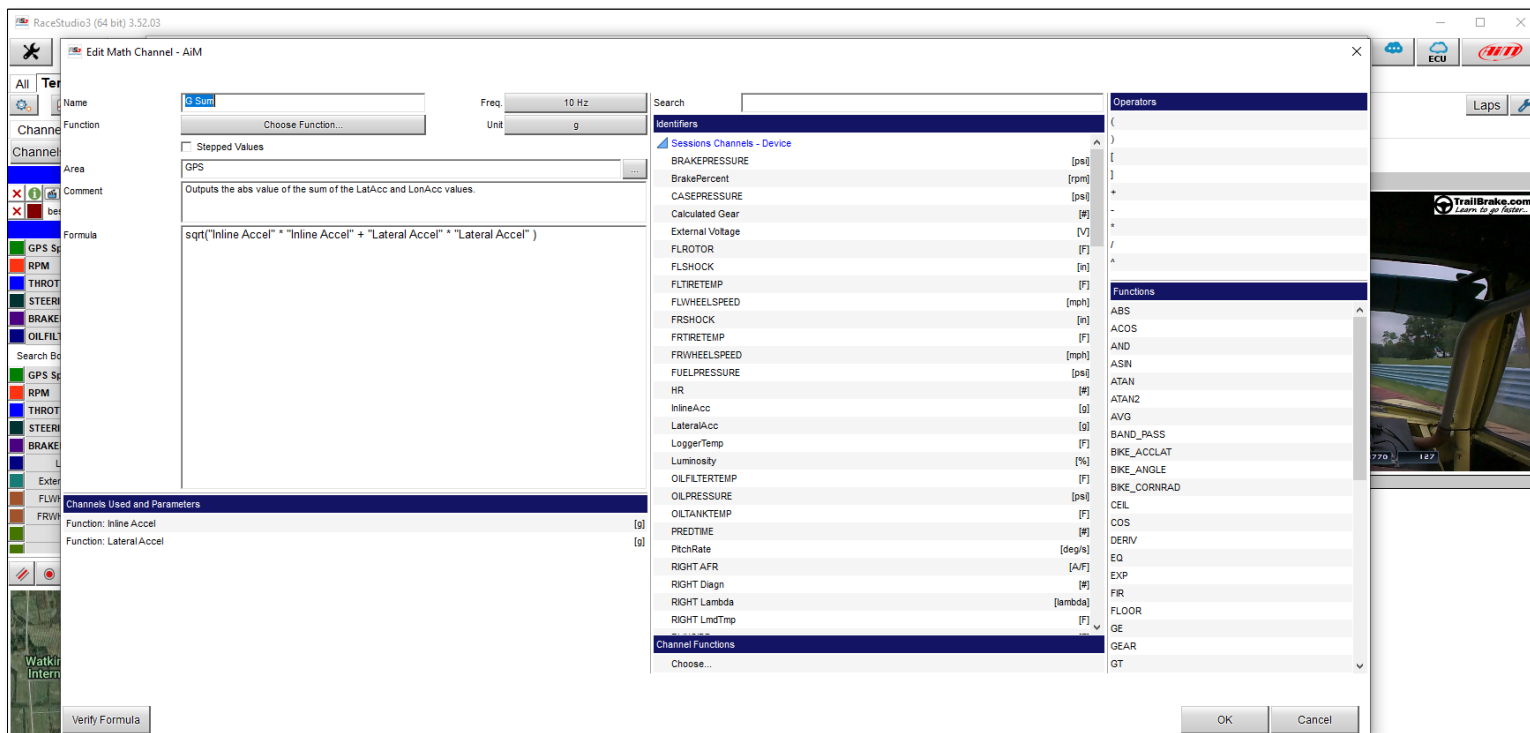
RS2 Analysis to RS3 Analysis

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