

RS3 - Math Channel News!



Math Channels

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Channels Library

1 AM Webinar 8-13-2024

Acceleration (Inline Acceleration)

Braking Gs (Inline Acceleration)

Corner Radius Filtered (Distance)

Count Lifting (Number)

Distance (Distance)

Distance Coasting (Distance)

Distance To Brake On (Distance)

Lap Cumul Accel (Inline Acceleration)

Lap Cumul Lat G (Lateral Acceleration)

Point Brake Off (Number)

Point Brake Off Cond (Number)

Point Brake On (Number)

Point Brake On Cond (Number)

Point Throttle On (Number)

Point WOT (Number)

Speed After Point Throttle On (Speed)

Speed Until Point Brake On (Speed)

Speed Until Point Throttle On (Speed)

Switch Brake Off to Point WOT (Number)

Switch Brake On (Number)

Switch Brake On Cond (Number)

Switch Coasting (Number)

Switch Lifting After Brake Off (Number)

Switch Throttle On (Number)

Switch WOT (Number)

Throttle Velocity (Rate Throttle Pedal Load)

A SMX Aii - 2025

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AIM Webinar June 2024

Barnum

Chiquita

Drag Truck

GPS

Comment

Only longitudinal Gs which are greater than 0 meaning the car is accelerating.

Formula

"GPS LonAcc"[g] > 0 * "GPS LonAcc"[g]

Channels Used and Parameters	Notes, Warnings and Errors while Applying Channel to Session(s)
Channel with name exactly matching: GPS LonAcc	27 - 2025, May 03 3:34 PM
Channel with name exactly matching: GPS LonAcc	Math formula translated for session: "GPS LonAcc"[g] > 0 * "GPS LonAcc"[g]
	No error(s) in this session

Verify Formulas

Recompute

Exit

Host:
Roger Caddell
AiM Sports

Co-Host:
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AiM-Sportline

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What's New?

New operators have been added, basically to give, in the math channels, all the possibilities available in the channels report.

- Report Operators
- Integrals
- Lap operators
- Segment operators

Math Channels DLL

Let's add some details....

Report Operators

We started from some feedbacks arrived, reporting that some functionalities available in the channels report were not so easily computable in the math channels and would have been a “nice to have”.

We added, as operators:

- AVG, AVGABS, AVGNZ (average, average of abs, average non zero)
- PCTL (percentile)
- PCTNZ (percent non zero)
- VRNC (variance)

Percent vs Percentile

In the math channels we have now added concepts like percent (PCT) and percentile (PCTL). They tell us different things.

Let's make some examples.

Percent can be used for example to compute how much is the percentage of my total time spent at full throttle.

Percentile can be used for example to compute which are the most common position values for my suspension travels.

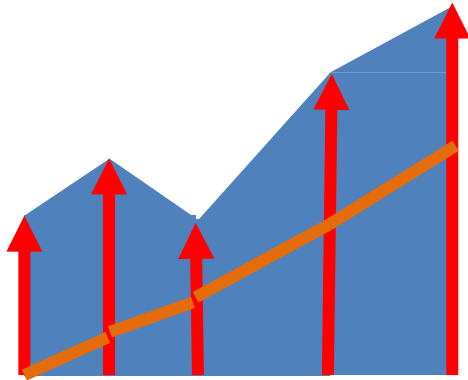
Report Integral

If you add an integral computation into the channels report, you'll see the value of the integral channel at the end of the lap, as the computation engine integrates through all the lap.

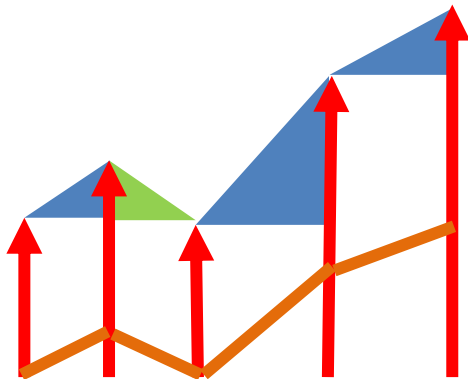
BTW, all the lap or all the segment, as the channels report can be computed also on segments.

Now, in the math channels, we can have the same value you see in the channels report.

Delta Integral



Integral (INTEG), the vertical arrows represent the samples of the channel being integrated. The result channel value (light brown colored) builds up according to the depicted areas.



Delta Integral (DELTA_INTEG), same meaning for the vertical arrows. The result channel value (light brown colored) builds up according to the depicted areas, that are differences between samples values.

Delta Integral

To add some words on the 'integral' explanation, let's start from its opposite operation (mathematically): the derivative.

When you compute the derivative of a channel, you're computing its slope. At a given instant, the more a channel grows, the higher its derivative will be.

The delta integral is taking your actual channel as a slope and will be giving you as a result, the original values your channel is slope of.

Lap Operators

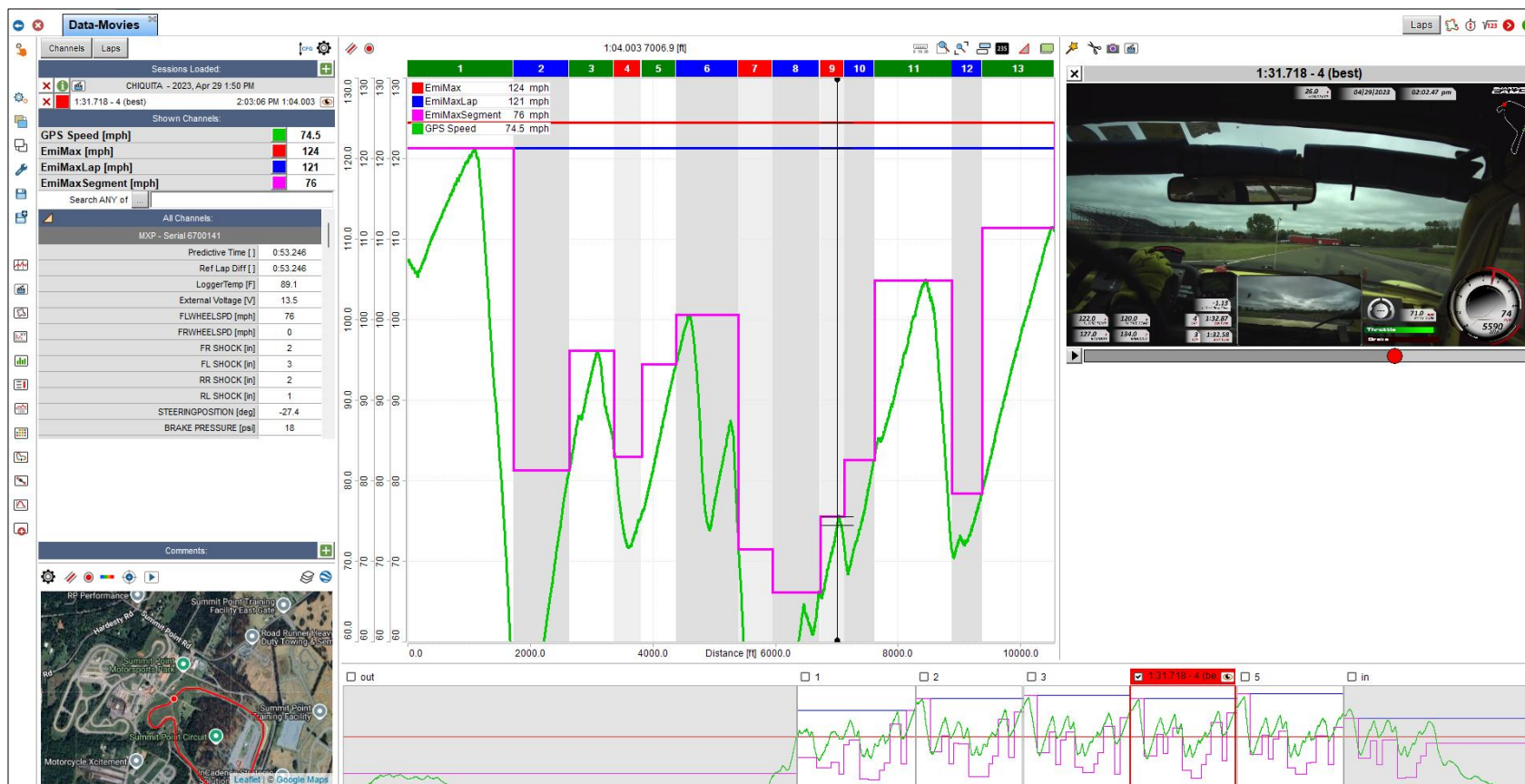
Let's take as example the MAX operator.

When used with a single channel, it computes the maximum value of the channel itself within the session.

MAX("GPS Speed"[mph])

We added the LAP_MAX, and the SEGMENT_MAX.

Lap Operators



Segment Operators

You will have the same possibilities that you have with laps, also for segments.

Pay attention that all math channels featuring one of these operators **will not be automatically recomputed upon any change in segments.**

You will need to **manually trigger the recompute** button, either in math channels dialog window or in channel settings dialog window.

Alternatively, they will be **automatically recomputed while reloading the sessions.**

Math Channels DLL

What are we speaking of?

It's the possibility of creating a sort of RS3 plugin, that allows you creating all the channels you need.

Do I need to be a programmer?

You need to know some C++ programming.

Do I need any 'strange' or 'licensed' software?

No, you only need a C++ programming IDE. What we normally advice for is Microsoft Visual Studio Community Edition.



Math Channels DLL

Tell me one thing that I can do with the DLL that developing a DLL would allow me for.

You'll be able to distribute math channels to any friend/customer of yours without sharing your IP (Intellectual Property).

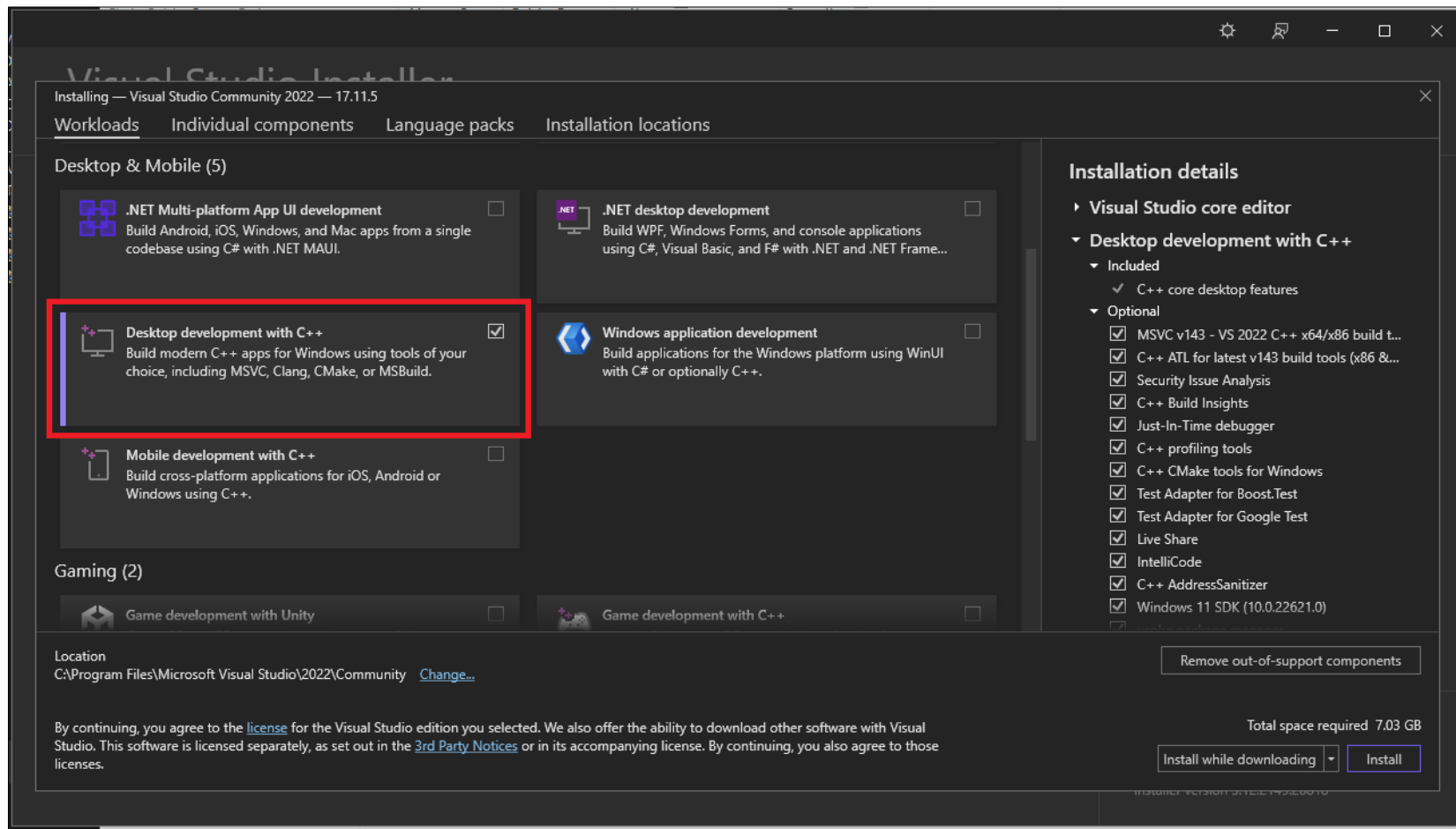
You'll also be able to create math channels that apply to a specific logger, referencing it with its logger unique ID.

Math Channels DLL

Let's make it work.

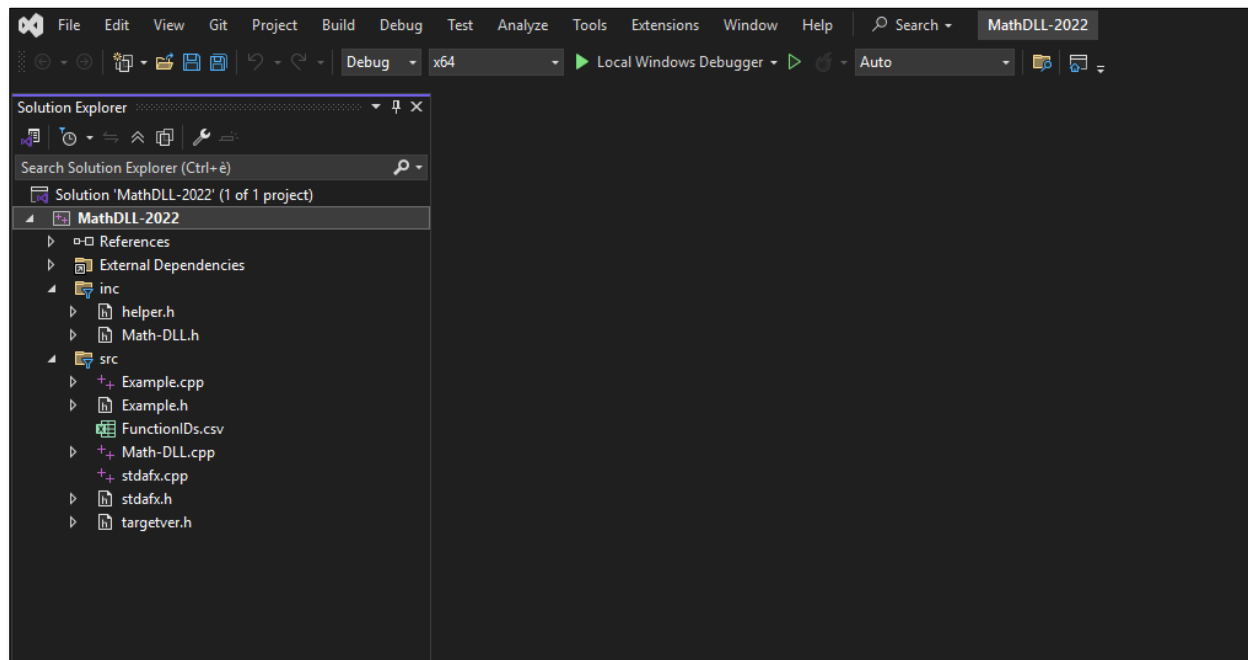
1. Download the template project zip archive and extract it into any folder on your drive (it's a Microsoft Visual Studio project)
2. Download and install, if you don't have it already, the Microsoft Visual Studio Community Edition, here:
<https://visualstudio.microsoft.com/vs/community/>
 1. During the installation process, flag the "Desktop Development" as in the following slide
3. In the extracted folder, you'll find a folder named msvcpp, open it and double click on the "MathDLL-2022.sln" file for opening the solution in Visual Studio...

Math Channels DLL



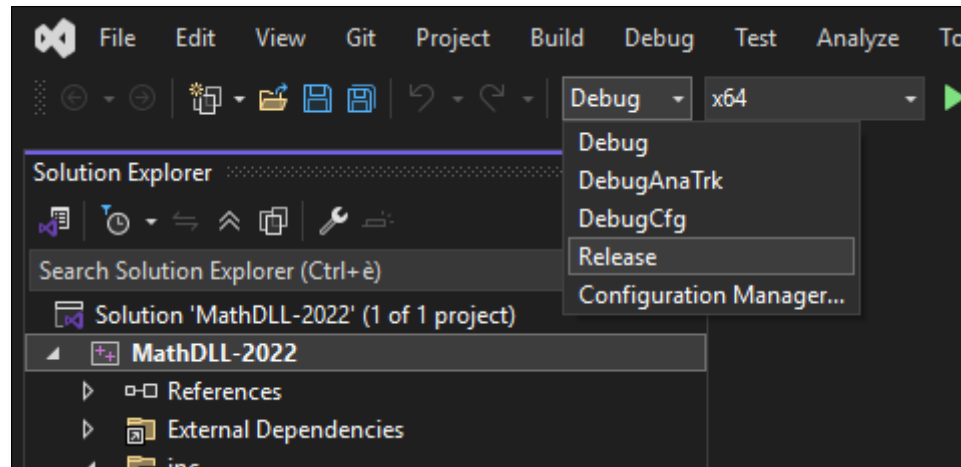
Math Channels DLL

The main Visual Studio Window should appear like this.
There's a list of files, double click on them to open and see their source code.



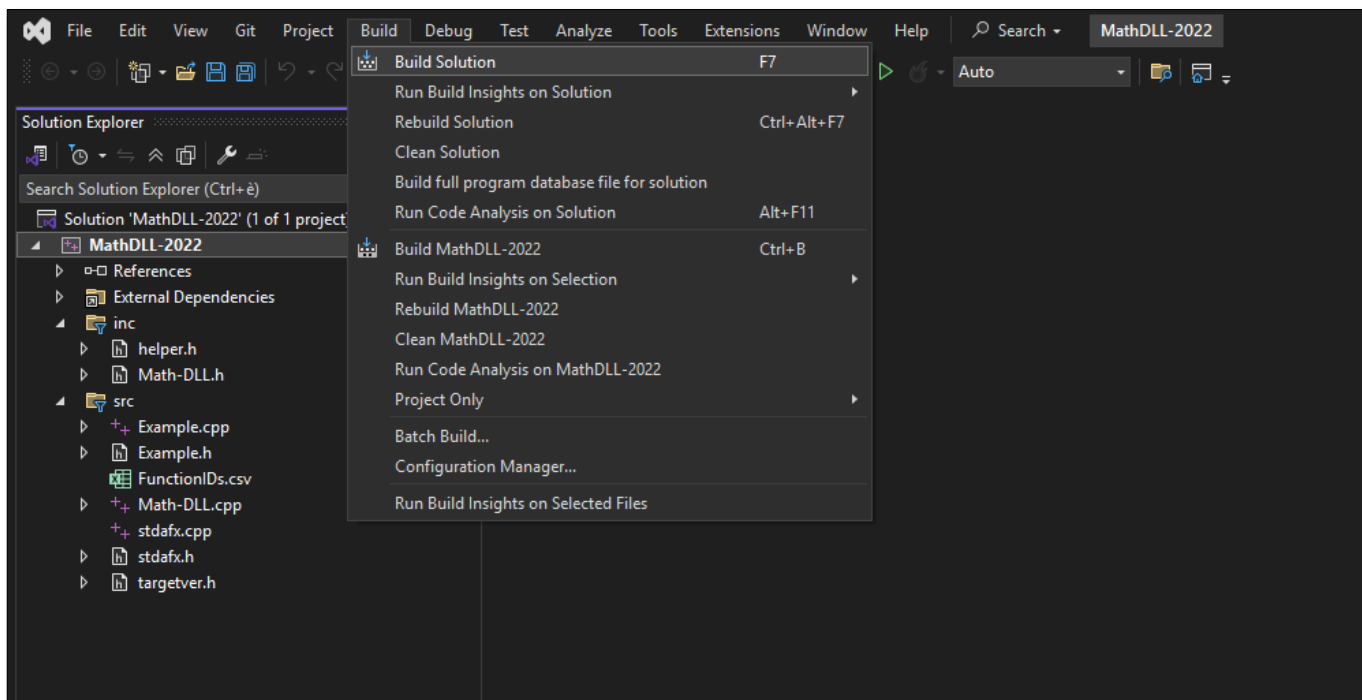
Math Channels DLL

Switch the configuration to 'Release'.



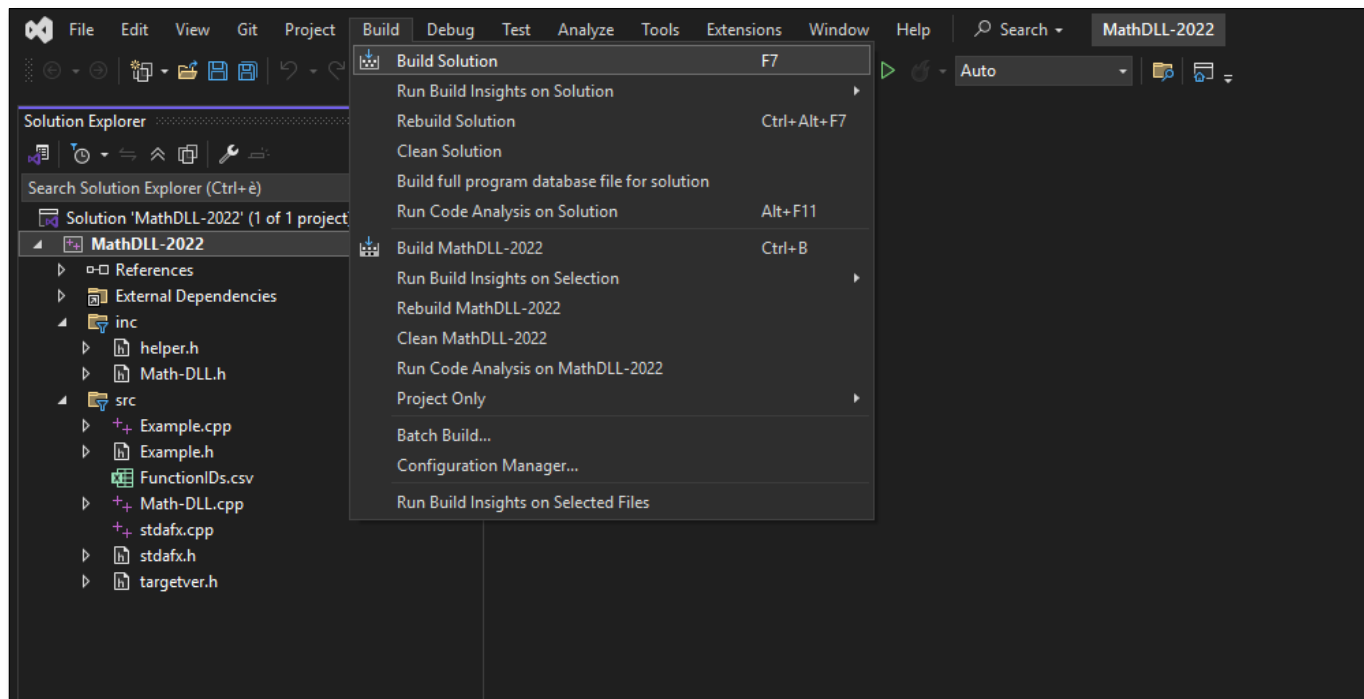
Math Channels DLL

Select the menu “Build/Build Solution”



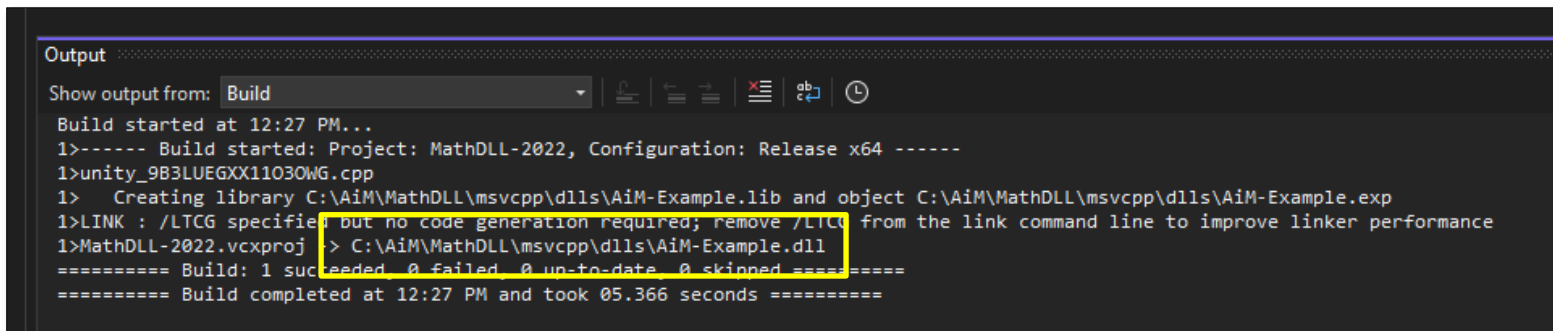
Math Channels DLL

Select the menu “Build/Build Solution”



Math Channels DLL

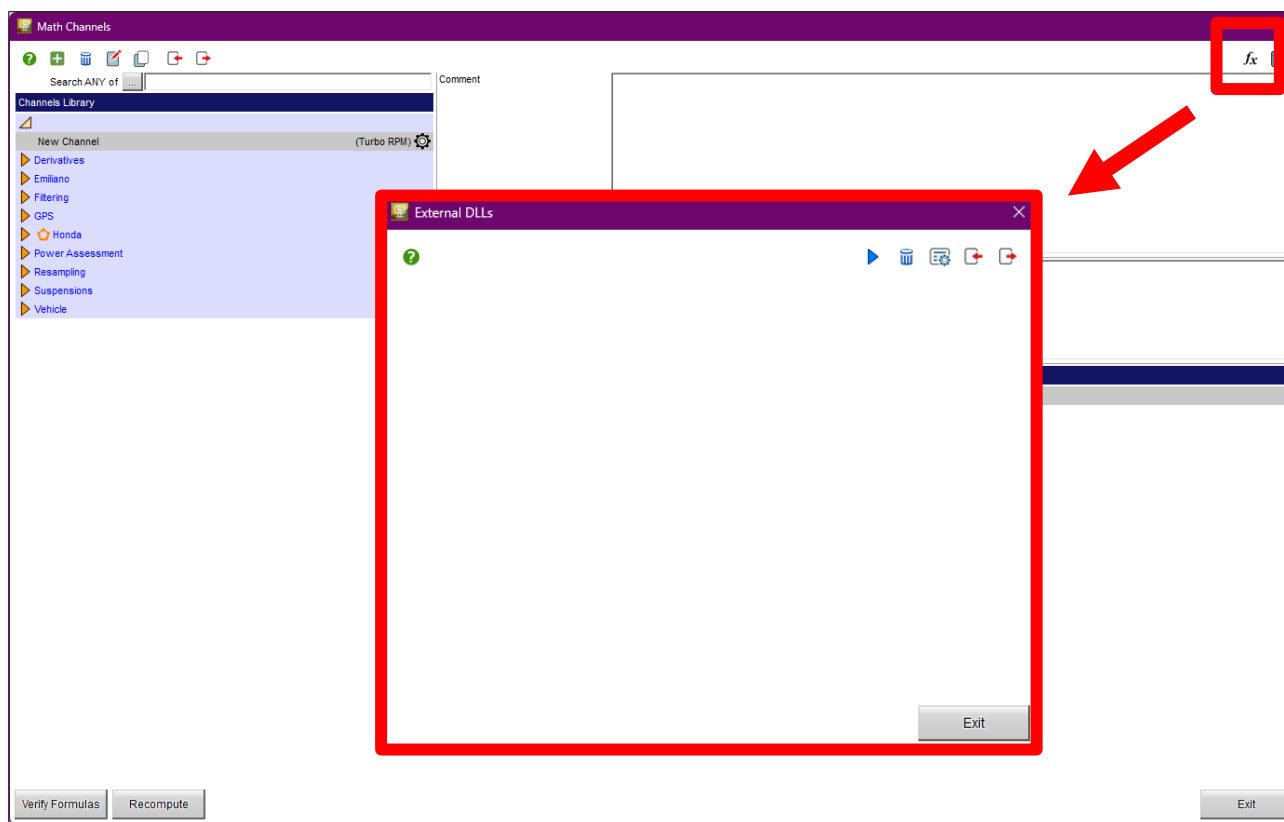
Upon build completion you will be prompted an “Output” window telling you, as last thing, where the compiled DLL has been placed.



```
Output
Show output from: Build
Build started at 12:27 PM...
1>----- Build started: Project: MathDLL-2022, Configuration: Release x64 -----
1>unity_9B3LUEGXX11030WG.cpp
1> Creating library C:\AiM\MathDLL\msvcpp\dlls\AiM-Example.lib and object C:\AiM\MathDLL\msvcpp\dlls\AiM-Example.exp
1>LINK : /LTCG specified, but no code generation required; remove /LTCG from the link command line to improve linker performance
1>MathDLL-2022.vcxproj -> C:\AiM\MathDLL\msvcpp\dlls\AiM-Example.dll
==== Build: 1 succeeded, 0 failed, 0 up-to-date, 0 skipped =====
==== Build completed at 12:27 PM and took 05.366 seconds =====
```

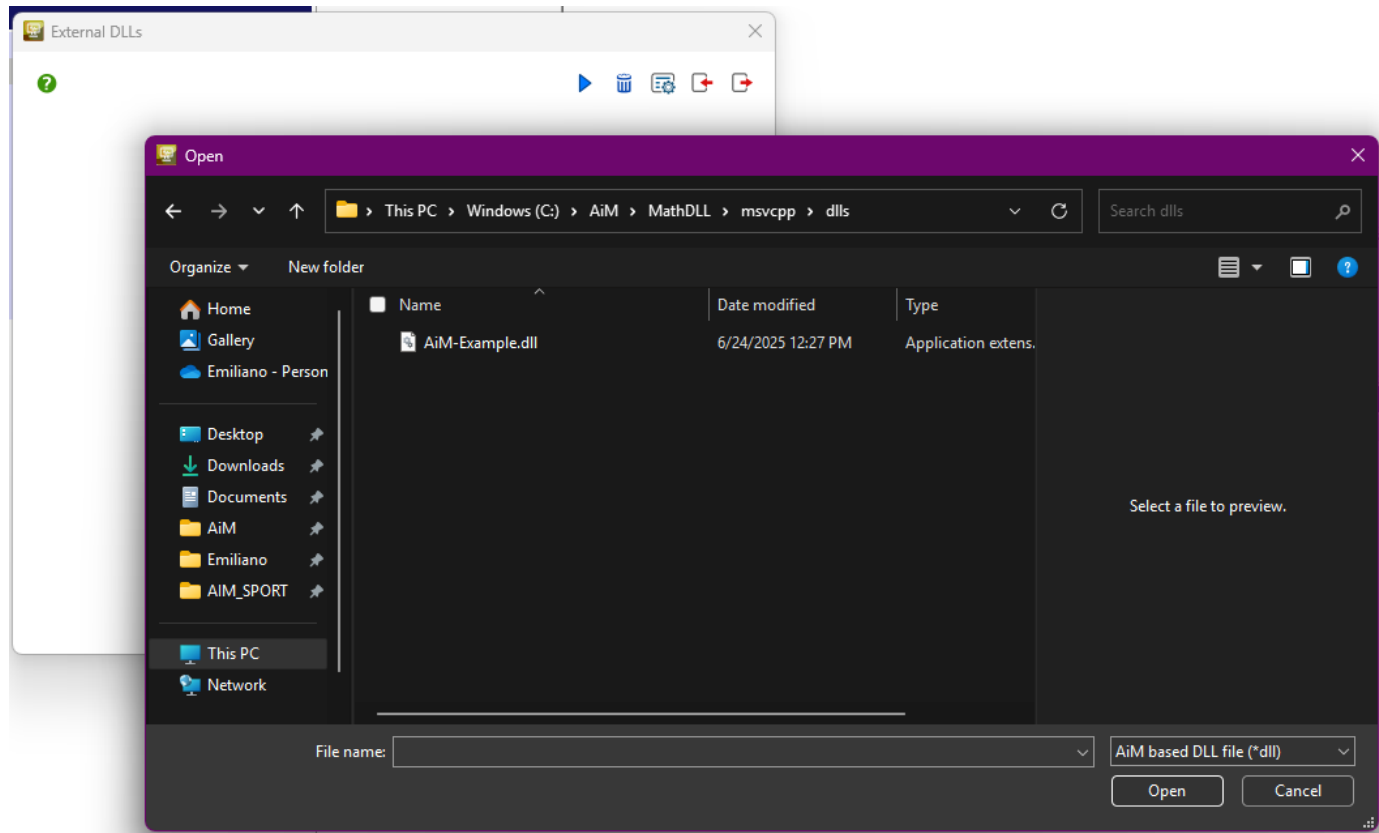
Math Channels DLL

Within RaceStudio 3, open the math channels application window and look for the small 'fx' icon. Click on it, a new dialog window will appear.



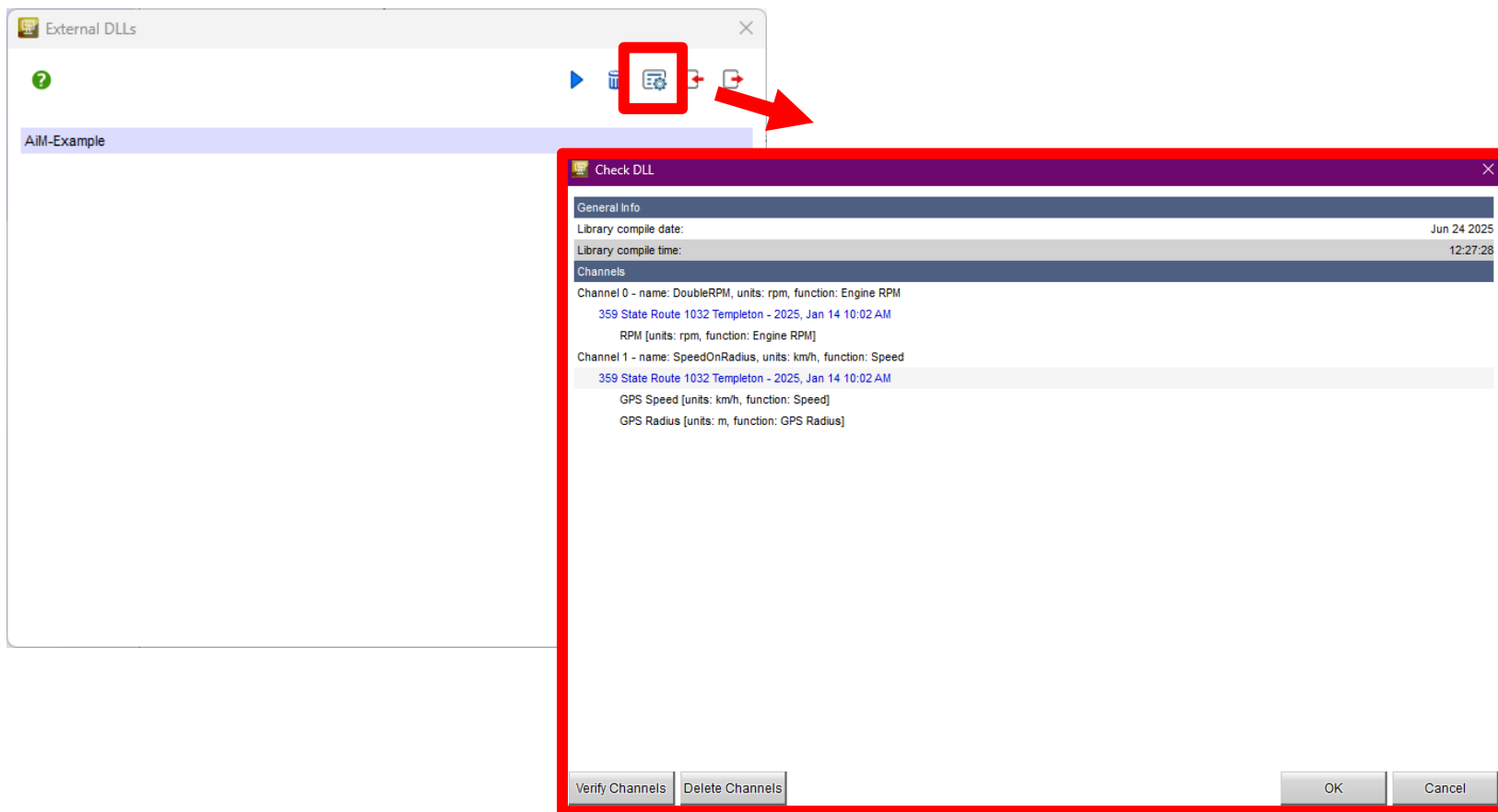
Math Channels DLL

In the DLLs window, click on the 'import' icon and navigate to the newly created DLL to import it.



Math Channels DLL

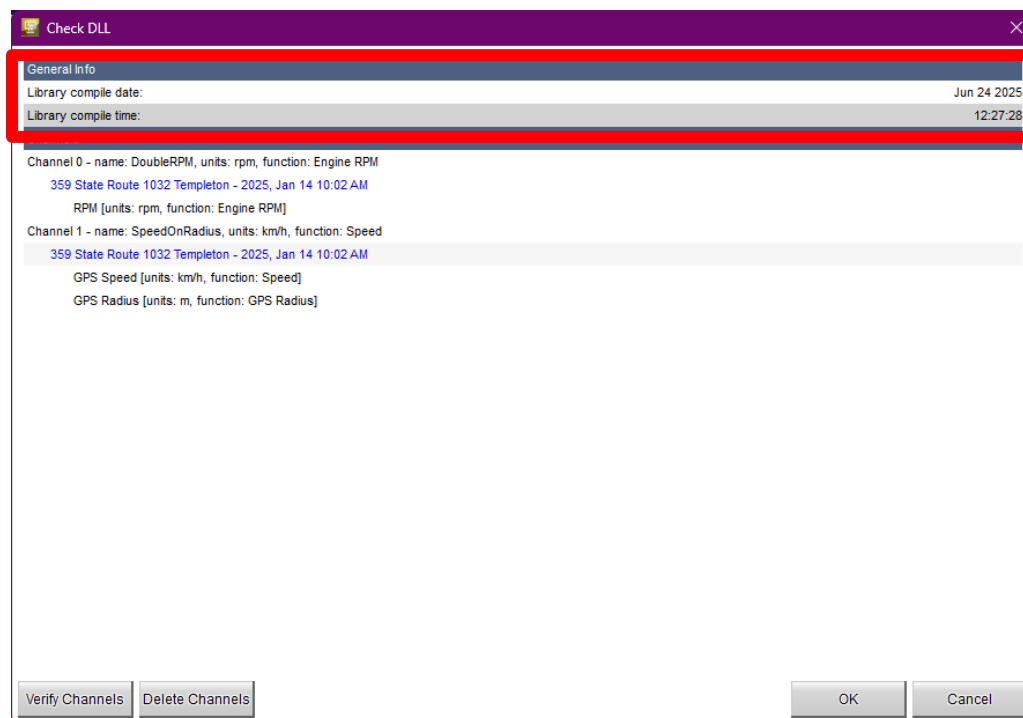
Once imported, the window will appear like this. The properties icon will allow you to check the DLL and its channels.



Math Channels DLL

The Check DLL window will allow you to see and evaluate problems during the development of your own channels.

Always check the compile date and time of your DLL, so that they match your latest build. Then check for possible mistakes.



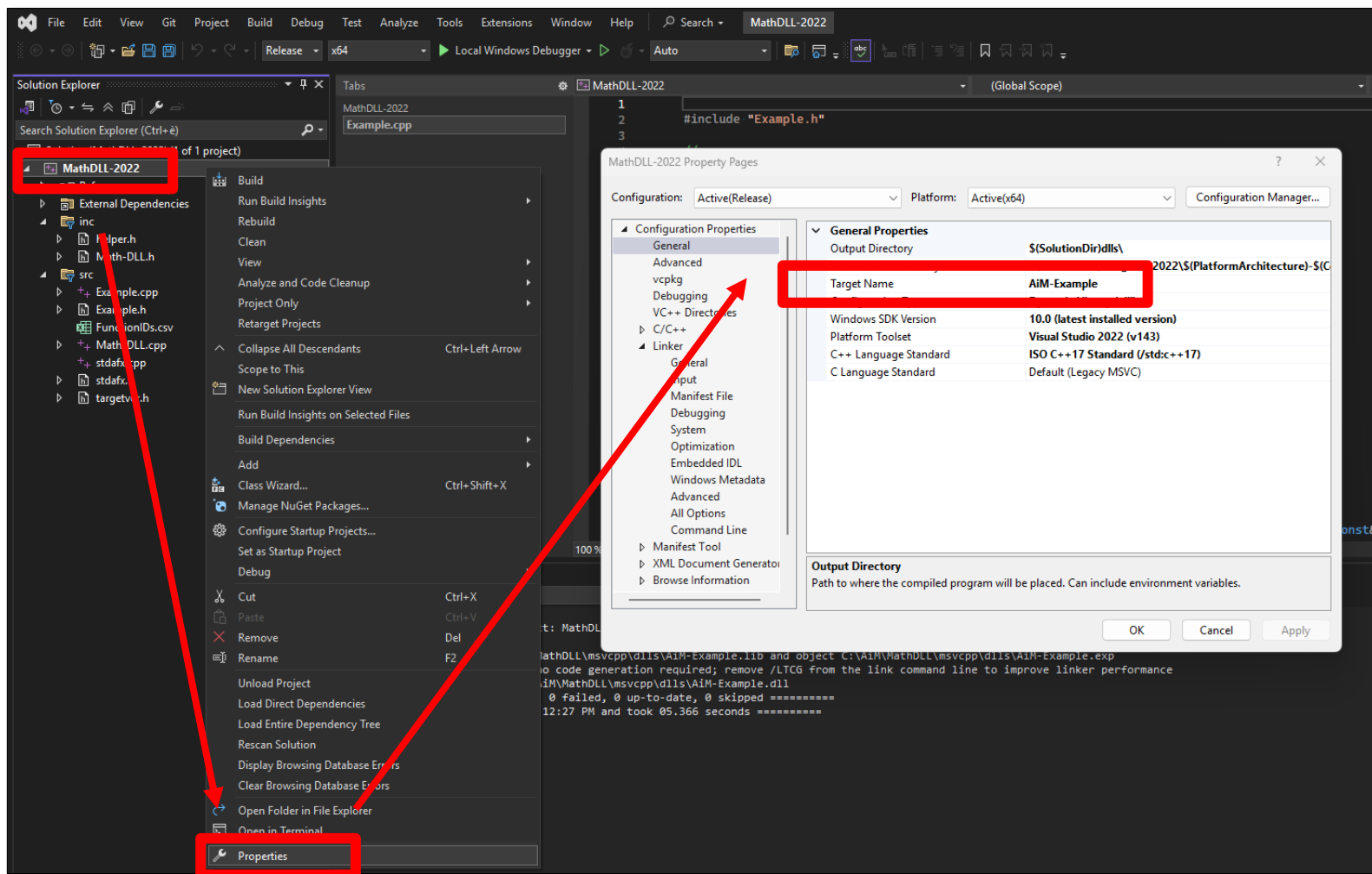
Math Channels DLL

The supplied solution generates a DLL with name "AiM-Example". To change it...

1. Right Click on the MathDLL-2022 project and select 'Properties'
2. Doublecheck the configuration is 'Release'
3. Identify the 'Target name' field, and change it

Please remember that you're changing the DLL in the compilation folder, you'll have to import it in RaceStudio 3 again.

Math Channels DLL



The screenshot shows the Visual Studio IDE with the 'MathDLL-2022' project selected in the Solution Explorer. The 'Properties' window is open, displaying the 'General' tab. The 'Target Name' is set to 'AiM-Example'. The 'Output Directory' is set to '\$(SolutionDir)dlls\'. The 'Configuration' is 'Active(Relase)' and the 'Platform' is 'Active(x64)'.

Below the 'General' tab, the 'Linker' tab is visible, showing the 'General' sub-tab. The 'Output' field is set to '\$(SolutionDir)dlls\AiM-Example.lib'.

The 'Output Directory' field is highlighted with a red box, and the 'Target Name' field is also highlighted with a red box. A red arrow points from the 'Target Name' field to the 'Output Directory' field.

RS3 – Math Channel News

Math Channels DLL

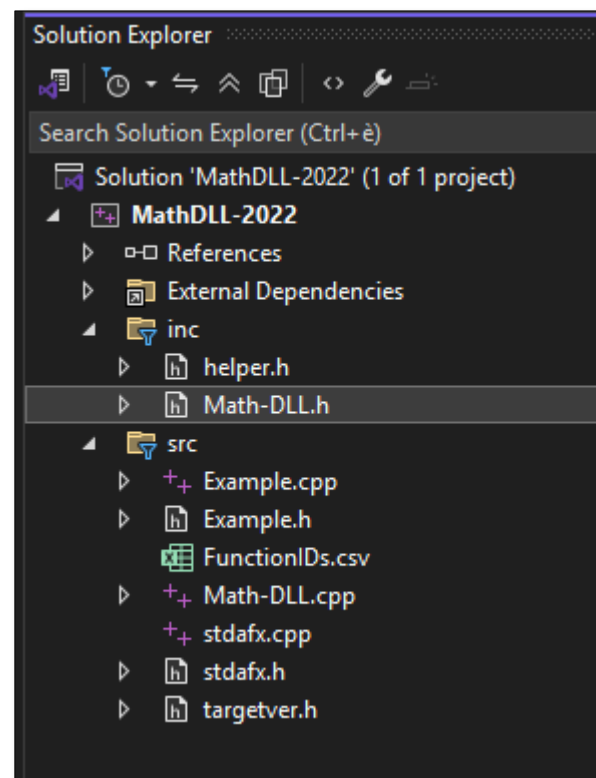
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Math Channels DLL

Source code. Start from the “Math-DLL.h” file.

The RaceStudio 3, while computing your channels, will be calling all the functions declared here, and every function feature, here, its own help illustrating what it does.

The implementation of every function is in the “Math-DLL.cpp” file. You’ll see it, in the project tree, a little below.



Math Channels DLL

“Math-DLL.cpp” file.

Start examining the “init()” function. In it you can find two examples of working channels and some examples of channels with common issues (all explained).

Place the cursor on the “SMathChannel_Example1” word, right click and select “Go to Definition”, to see some more.

```

void init()
{
    ...if ((!is_initialized) && (!is_computing_now))
    ...{
        ...math_channels.push_back(&SMathChannel_Example1::s_me);
        ...math_channels.push_back(&SMathChannel_Example2::s_me);

    ...#ifdef BAD_CHANNELS
        ...math_channels.push_back(&SMathChannel_BadName::s_me);
        ...math_channels.push_back(&SMathChannel_BadUnit::s_me);
        ...math_channels.push_back(&SMathChannel_BadFreq::s_me);
        ...math_channels.push_back(&SMathChannel_BadFunction::s_me);
        ...math_channels.push_back(&SMathChannel_BadInputName::s_me);
        ...math_channels.push_back(&SMathChannel_BadInputUnit::s_me);
    ...#endif // BAD_CHANNELS

    ...is_initialized = true;
    ...}
}
    
```

Math Channels DLL

Go ahead and explore the example channels, both in the “Example.h” and “Example.cpp” files.

You will be seeing how a channel of your own must be declared and implemented.

The «Compute» function is the one that you will be called and it's the function you need to modify in order to implement your computations.

```
struct SMathChannel_Example1
{
public: SMathChannel
{
static SMathChannel_Example1 s_me;

SMathChannel_Example1();
~SMathChannel_Example1();

void Compute(SComputedChannel& session_channel) final;
};
```

```
SMathChannel_Example1 SMathChannel_Example1::s_me;

SMathChannel_Example1::SMathChannel_Example1()
: SMathChannel("DoubleRPM", "rpm", 10.0, "Engine RPM")
{
m_needs_same_timestamps_for_all_channels = true;
m_input_channels.push_back(SInputChannel("RPM", "rpm", "Engine RPM"));
}

SMathChannel_Example1::~SMathChannel_Example1()
{
}

void SMathChannel_Example1::Compute(SComputedChannel& session_channel)
{
if (Verify(session_channel))
{
std::vector<SSample>& input_samples_rpm = session_channel.m_input_channels[0];

size_t const tot = input_samples_rpm.size();
session_channel.m_samples.resize(tot);

for (size_t ii = 0; ii < tot; ++ii)
{
session_channel.m_samples[ii].m_timestamps_us = input_samples_rpm[ii].m_timestamps_us;
session_channel.m_samples[ii].m_value = input_samples_rpm[ii].m_value * 2;
}
}
}
```



Math Channels DLL

Here's a starting point. Roger and me will be recording a dedicated video very soon. Stay tuned... 😊

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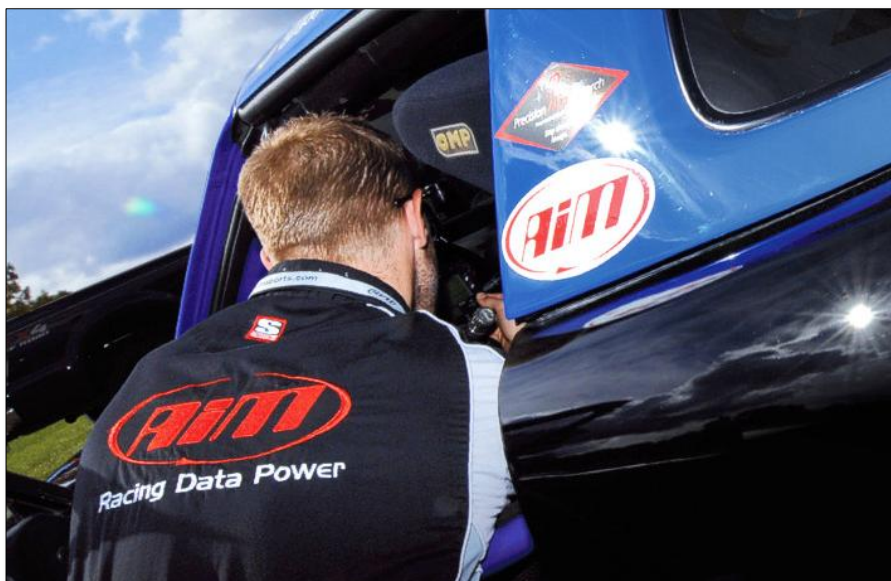
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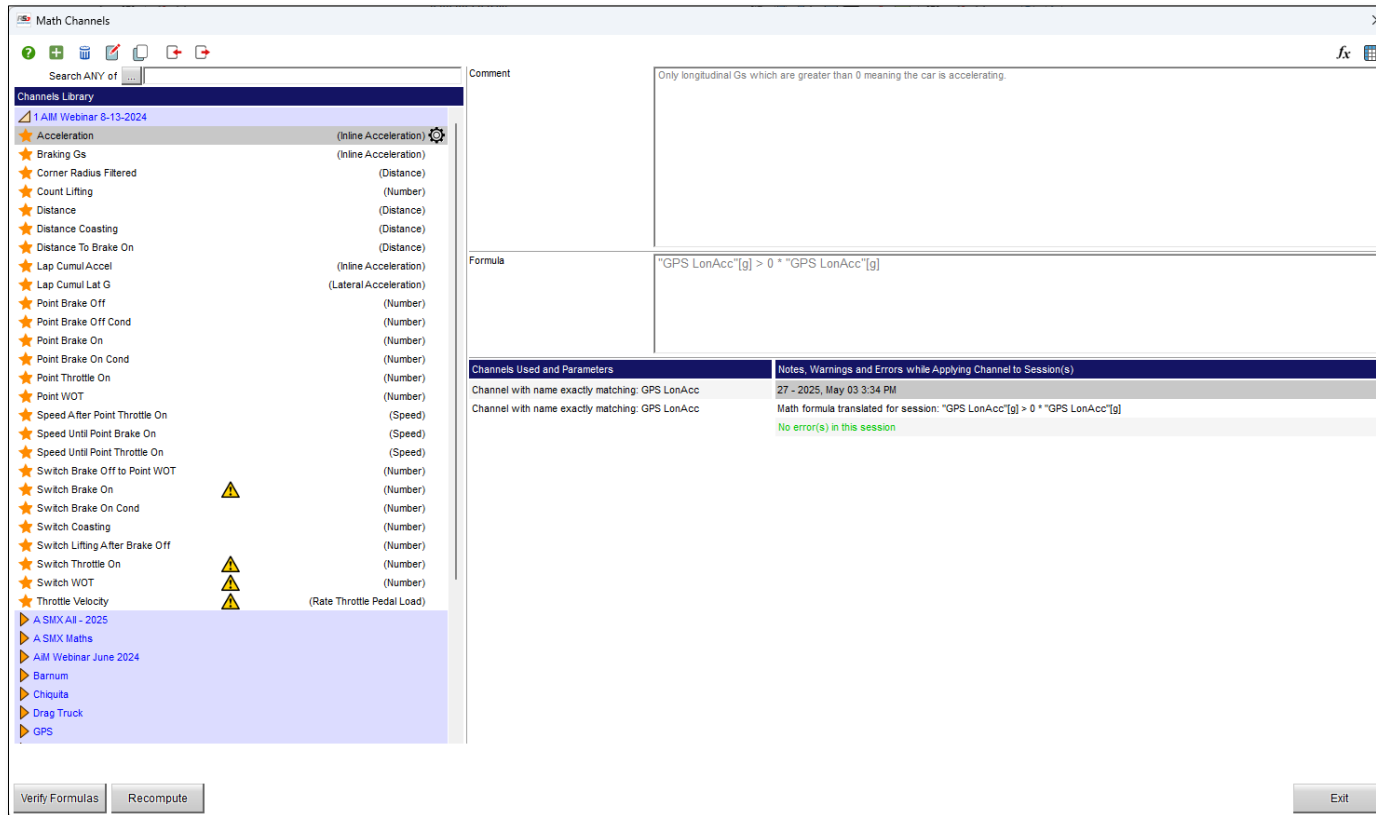
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