Release Notes Version 2.2

Accelerated ISF

As a prerequisite please study the documents for the original autoISF (Github) and the draft for versions 2.0/2.1 (private communication).

The term „accelerated ISF“ refers to the main new feature, the adaptation of ISF based on the acceleration of the glucose level. The regular AAPS does not use the glucose acceleration may be apart from some rough estimate by comparing delta, short average delta and long average delta. But even if so such a number is not up to date as it uses data 40 minutes from the past. The method used here first calculates a best fit of the recent glucose to a parabola. once that formula is known it is an easy second step to calculate best delta and accelerations as first and second derivatives of glucose:

$$\begin{aligned} gluc(t) &= a_2*t^2 + a_1*t + a_0 \\ delta(t) &= 2*a_2*t + a_1 \\ acce(t) &= 2*a_2 \end{aligned}$$

This is a well known trick in science to fit a theoretical curve or surface to measured data and then the downstream analyses become easy and fast using these analytical formulae. Also, this fit has a smoothing effect.

This whole context reminds me of Newtons 2nd law, this time expressed inversely: if a body experiences an acceleration then there is a force acting on it. By analogy, if glucose accelerates there is some „sweet force“ acting in the system driving glucose higher and we should counter it by more insulin, e.g. strengthening ISF. Likewise, if glucose decelerates there is some „antisweet force“ driving glucose down and we should counter it by reducing insulin, e.g. weakening ISF. Not knowing anything about the metabolism behind accelerated glucose the easiest starting point is a linear change of sensitivity with acceleration:

$$acce\_ISF = 1 + acce * weight$$

There are two independent implementations of that weight factor and both can be defined in Preferences → Absorption Settings -> Advanced:

1. *bgAccel_ISF_weight* is used for positive acceleration. With 0 there is no change and the higher the number the more aggressive it will react. Start small, e.g. 0.02 and increase it gradually. Using the emulator I had figured that 0.15 might be a suitable starting value for me. I worked my way up to 0.17 but it is still early days … and YDMV.

2. *bgBrake_ISF_weight* is used for negative acceleration, i.e. deceleration. With 0 there is no change and the higher the number the stronger the „braking“ effect will be. The main purpose is to slow down IOB build up thus reducing the risk of a hypo later on. On the other hand it will also slow down the decline in glucose levels and you need to find your own balance. Start small, e.g. 0.02 and increase it gradually. I worked my way down from 0.15 found in the emulator down to 0.13 but it is still early days … and YDMV.

I guess these two weights will be of similar size in the end. Because acce_ISF can be below 1.0 we now need a lower limit contained in the newly introduced *autoisf_min* which can be found in the Preferences right next to *autoisf_max.* A value of 1.0 would obviously shut off the effect of „braking“. This lower limit will now also be active when glucose is low and ISF would go sky high

in version 2.0. In that respect version 2.2 behaves different from versions 2.0 and 2.1. One of the first things to do after starting version 2.2 is to define this minimum value because the default is 1.0 !

Combining the adaptations

So far in autoisf all the impacts from resistance, bg level, delta, postprandial meal absorption and now acceleration were independent of each other and the strongest one would be used. With the introduction of acceleration this priciple was given up. The reason is that on many äccasions the acceleration impact points in the opposite direction of where the other reasons want to go. The two scenarios are:

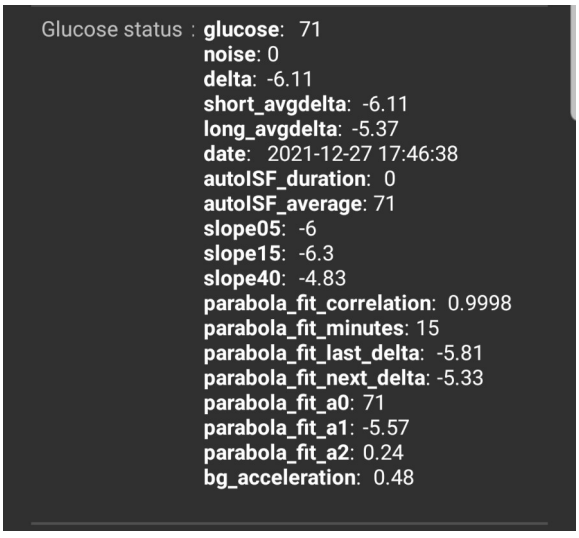
1. Acceleration is positive, but glucose is below target and bg_ISF wants to weaken ISF – this can happen if carbs were taken, bg rises but is still below target. Here half of the acce_ISF is used and multiplied with bg_ISF and they meat somewhere in the middle. In the future this fixed 50% contribution may be too simple and may need to be refined.
2. Acceleration is negative, glucose is above target and some autoISF functions want to strengthen ISF – in this case adding to IOB should be reduced by what the deceleration says. The resulting effect comes from multiplying acce_ISF with the strengthening ISF factor and we end up somewhere between the two. This can be below 1.0 (potentially save insulin) or above 1.0 (potentially more insulin). It is only potentially because in the end only the loop algorithm decides on the insulin required and just uses the adapted ISF.

How do you see what is going on and why?

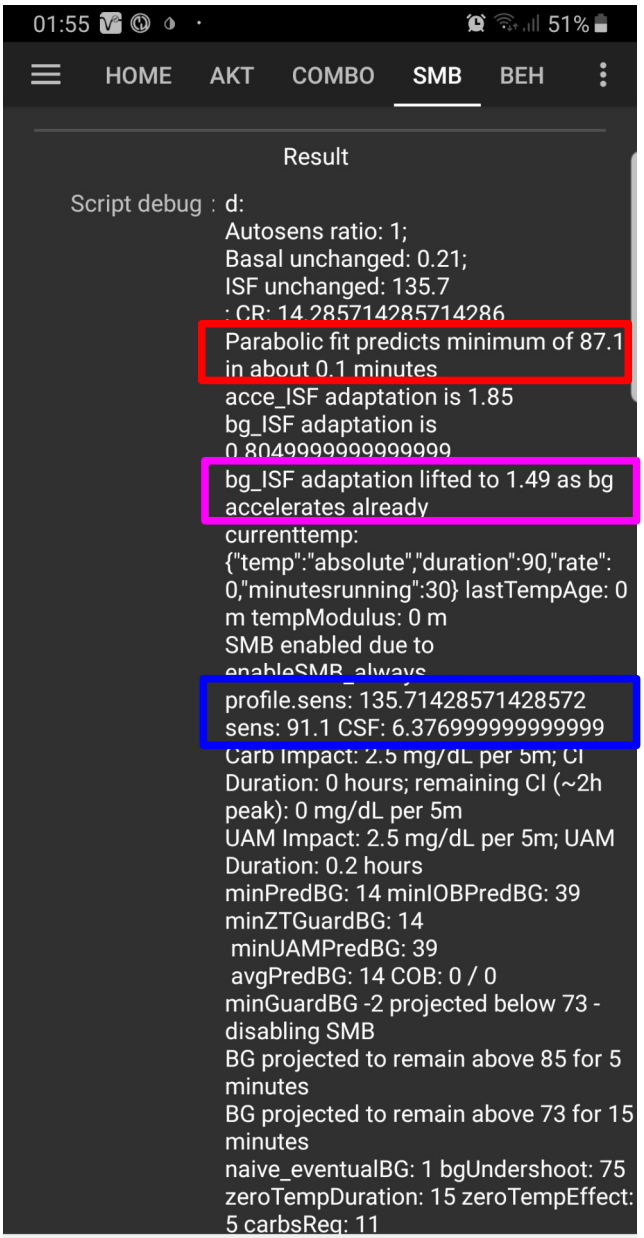
The SMB-tab shows much more information than before. In the end some of that may not really be required or significant and can be removed in the future.

1. Glucose status shows detailed results from the fit. It now also lists the coefficients of the fit. The time units are per 5min or (per 5min)^2, respectively. These are used further don in Results t calculate when and where the parabola had or will have its maximum or minimum.

   After the evaluation phase some of these may be removed.



2. The Results section goes through the decision sequence by listing all the potential contributions to the adapted ISF.
    - Echo of where and when the parabola has its minimum or maximum. The example here is the most useful of the possible combinations because it forecasts when and where the minimum might occur. Befre, I did that maths in the top of my head. It can theoretically be consulted when extra carbs are required to judge whether they are really required. However, this has to be watched carefully and please let me know whether it works and is reliable. If not, it should not be listed at all.
    - Echo of the combined effect of acceleration and opposing other reason.
    - The resulting ISF is shown as usual.



Things to investigate

1. Why does it take so long to reach target again once glucose is below target? It looks like the acceleration impact is too strong in these cases.
2. What happens if meals are announced in the typical AAPS way? Will there be too much insulin?
3. How should the combination with autosens be handled? I have not used it for the last 18 months so it slipped my attention.
4. How does it handle gastroparesis?
5. Do we still need the contributions from delta?
6. Read more on Tim Streets method and implementation of his „no bolus“.

Results and Examples …