

4. Meals: Setting ISF_weights in /Preferences

v.5.2



Please note that with autoISF you are in an early-dev. environment,

where the user interface is **not optimized for safety** of users who stray away from intended ways to use. Good safety features exist, but these are only as good as the development-oriented user understands and implements them. This is not a medical product, refer to disclaimer in [section 0](#)

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[Available related case studies:](#)

[Case study 4.1: Pizza](#)

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[Case study 4.3: Hands-off FCL on Xmas](#)

4.1 Getting started

Caution: This entire e-book is about Full Closed Looping (FCL).

In case you intend to work with giving boli, many suggestions made - notably in this [section 4](#), and in [section 2](#) – should **not** be followed. Y

You should then primarily use the autoISF Quick Guide (from <https://github.com/ga-zelle/autoISF>), and **do extra research**, on your own data. (Look at the chart in [section 4.1.2](#) - your bolus very much would change things there!).

If you shy away, for now, from FCL, please have a look into sections discussing methods with “**Meal Announcement**”, [section 07](#), and [section 13.3](#)-

4.1.1 Reminder of pre-requisites

This section 4. is about the core FCL aspects of autoISF. Before doing anything with this section, please make sure you have studied the preceding [sections 1](#) and [2](#) on the general pre-requisites for FCL and the developers “Quick guide” (see [section 3](#)) on the principal workings of autoISF.

Core points are briefly summarized below.

Start with proper “safety” settings

Before you start tuning your autoISF for FCL, **make sure you have** appropriately:

- **widened the SMB size restrictions** ([section 2.1](#)),
- **elevated** the max allowed ISF amplification via your set **autoISFmax** ([section 2.2](#))

Both of these points are extremely important: If you set (or keep in place) narrow restrictions, this will **not** allow to see effects from a more aggressively tuned ISF. Even worse, it would cover-up too aggressive settings (e.g. on the ..._ISF_weights that we get to in a moment), and invariably make your loop bounce against the restriction(s).

This could even work fine, if your meal spectrum isn't broad: If, in your HCL, the **same** bolus size pretty much fitted all your meals, it could now, in FCL, be replaced by rushing, with super-aggressively modulated ISFs, into the set restrictions, to produce - with only a brief delay – the required iob that would be about equivalent to what you formerly had bolussed in your HCL.

A system that is really fit **for the variance** we all like to enjoy in our daily lives, though, would be characterized by “tolerating” pretty wide open safety restrictions*), while having cautiously calibrated other, notably ISF modulating, parameters (as described in [sections 4.2 – 4.5](#)).

*) Still, for safety (as also suggested in section 2.1 and 2.2), start your tuning on a middle ground, and only gradually widen SMB size and autoISFmax during your initial tuning.

80 Also make sure you have

- 81 • **set your iobTH%** (refer to [section 2.4](#) and if available [4.8](#))

82

83 Furthermore, in your early test phase, it is recommended to:

- 84 • Run the system as dummy, not connected to your body (or, on own risk, connect only as long
85 as you watch closely)
- 86 • In AAPS preferences, switch your autoISF FCL (= **autoISF/”Enable adaptation of ISF to
87 glucose behavior”**) ON only during daytime hours of a meal, e.g. *11-18h*, for fully automatic
88 “full closed loop” management *of lunches*.

89 You can do this switching manually *at 11 h and 18 h every day, or* set up an
90 Automation that does that (see [section 3.4](#)).

91 Take **typical but not extreme** meals. Omit sweet drinks, or drink only slowly. You are going for a
92 “good enough” compromise, that works with your range of usual meals.

93

94 **It is wasted time to do a lot of iterations to “optimize” settings based on just 1 type of meal.**

95 See [case study 8.2](#)

96

97 Occasionally, watch the time-pattern of bg, iob (SMBs given), and insulin activity after meal start.

98 Aside from serious “mathematical” attempts to tune settings based on data from the SMB tab (or

99 the Emulator, section 10), just watching the curves develop on your AAPS main screen can, over

100 time, give you “a feel” what settings, and eating behaviors, are benign or detrimental to good %TIR
101 performance.

102

103 [Importance of proper profile ISFs.](#)

104

105 Starters on autoISF FCL who are coming from using HCL with **dynamicISF** must be aware of the
106 following: It is absolutely essential to build your FCL on a properly set **profile** ISFs (likely a
107 circadian pattern over 24 hrs).

108

109 It may not apply to you, but many dynamicISF users did never bother to determine their ISFs that
110 would maximize their HCL performance, but employ dynamicISF so to speak for going
111 „dynamically“ through a wide range of possible ISFs, until eventually hitting a sweet spot, and the
112 whole thing works better than before, with what they had *used* as a profile ISF (often only one, e.g.
113 coming from Autotune).

114

115 The following is important to understand, as it leads straight into the core idea behind FCL with
116 autoISF, too: It is a good idea to establish a well-running hybrid closed loop with set (non-dynamic)
117 **ISF** (set in **profile** for each hour of the day). That ISF must be **aggressive enough** that it gets you
118 down from a high around 200 mg/dl to target. That is roughly also the way you experimentally
119 determined it (so I hope. See [https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-](https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings/blob/HCL--settings-main-repo-(pdf)/ISF%20determination%20V.3.33.pdf)
120 [settings/blob/HCL--settings-main-repo-\(pdf\)/ISF%20determination V.3.33.pdf](https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings/blob/HCL--settings-main-repo-(pdf)/ISF%20determination%20V.3.33.pdf)).

- 121 • Using *that strong* value also at *lower bg*, (on the way “up” , after meal start), is very positive:
122 We do *not* want to have a *softer* acting loop when at *lower bg* (which is what dynamicISF
123 tends to do!). autoISF will, in contrast, temporarily sharpen your ISF when, at low bg,
124 acceleration is detected..
- 125 • On the way down from peak, towards glucose target, a somewhat too strong ISF should not
126 hurt because much of the time your loop (well supplied with insulin before, „on the way up“) is
127 zero temping , or at least has only a small gap to correct, from predicted bg to target bg.
- 128 • You have no business to be much above 200 mg/dl where an *even stronger ISF* may or
129 may not help. It sure does not help at an occlusion which is about the only reason to see
130 super high values as an experienced looper.

131

132 **Pegging ISF strength to bg level** therefore **does not make sense in FCL**. You will use the
133 autoISF toolbox to get strongest ISF **at low** but beginning-to-rise bg,

134

135 Note: There are very much refined versions of dynamicISF that can have beneficial applications,
136 notably in HCL ...And, yes, I know, bg levels can also correlate with insulin sensitivity. But let us not
137 get into “chicken or egg type” discussions.

138 Rather, focus on doing a good tuning job, and use superior approaches to account for sensitivity
139 changes in a more pro-active manner (before running into sky-high bg (or into hypos)):

140

141 Going to autoISF FCL, you absolutely must **anchor on the proper profile_ISF**.

142

143 The profile is not “set in stone”, though. To use above terminology again: **Pegging ISF strength to**
144 **your current insulin sensitivity** – very much like you had done all along in HCL - **does make**
145 **sense in your FCL...**

146 (...and the fact that autoISF afterwards “anyways” often strongly modifies ISF is not a reasonable
147 counter-argument).

148

149 There are fully automated, as well as manual ways for sensitivity adaptations of the profile ISF:

150

151 Profile ISFs can get **fully automatically adapted**, e.g. by Autosens, or by the Activity Monitor,
152 which in autoISF we rather use ([section 6.5](#)).

153 Which of your basic related settings (in AAPS/Preferences) produce exactly which adaptation can
154 be seen right in the top lines of your SMB tab, at each loop decision. Likewise, it can be retrieved
155 later in logfile analysis (see Emulator, [section 10](#))

156

157 Furthermore, when using autoISF you can – as you did in the past, e.g. around exercise, or in
158 times of illness – temporarily **manually modify** your profile ISFs

159

160 Also these effects are quantified in SMB tab and logfiles *).

161 *) Furthermore, the results from autoISF are explained in the SMB tab, and multiplied with (original or adjusted)
162 profile ISF to result in the ISF (called “sens”) used in the current insulinRequired calculation

163

164 All three top buttons in AAPS (%profile switch, exercise and TT) can be freely used to adapt to
165 changes in sensitivity/resistance, turning into a yellow color to alert you to this. (More about your
166 “FCL cockpit” see [section 5.2.2.](#)).

167

168 For a start, please spend a couple of days (if not weeks) to **get your key autoISF related settings**
169 **right**, strictly **on/for days with your normal insulin sensitivity**. This is what this [section 4](#) is
170 about.

171

172 [Importance of starting from a well-performing Hybrid Closed Loop](#)

173

174 A **satisfying performance in Hybrid Closed Loop** mode is a pre-requisite. Expect to reproduce
175 about the same %TIR also in your FCL, but with less daily interaction, once established.

176 Note that this refers to prior use of „vanilla“ software, without fancy „dynamic add-ons“ (such as:
177 Autotune determined factors, dynamicISF etc). that may have introduced bias into the profile
178 settings you bring with you into FCL now.

179

180 To reach a satisfying performance you must start from a hybrid closed loop in which you did
181 **master your meal management well** using theoref(1) algo SMB+UAM.

182 This is a pre-requisite **to be able to forget it** ... - because the initial tuning that we now turn to
183 demands, that you analyze your **prior best practice as your blueprint** to find appropriate settings
184 and „teach“ your FCL to come up with the necessary job.

185

186 This is the main subject of this section 4 (finding settings for automatic meal management).

187

188

189

190

191 Do not copy settings from other FCL loopers

192
193 When setting your parameters, don't use any given numerical example (not even as “a starting
194 point”). Instead, anchor on **data from your *successful* Hybrid Closed Loop!**

195
196 Most *examples given in this paper* are from an adult diabetic (Lyumjev, G6) whose insulin sensitivity
197 can be characterized as follows: approximately 37 U TDD, thereof 13 U profile basal, at about 200g
198 daily carbs from mainly lunch and dinner; no couch snacks or sweet drinks. The user also
199 participates in multiple instances of daily moderate exercise such as dog walking, biking and
200 gardening. In Hybrid Closed Loop, a typical meal bolus was 8 U that was sometimes reduced such
201 as when activity followed the meal.

202 After seeing some more inputs from a variety of users we might put together a profile helper for
203 some rough orientation, and for plausibility cross-checking, in [section 4.8](#)

204
205 Importance of going step-by-step

206
207 [Section 5](#) will explore avenues to manage “disturbances”, i.e. time blocks or situations that might
208 demand enhanced or reduced loop aggressiveness.

209 [Section 6](#) will focus on the exercise mode, and the activity monitor.

210 In case you have a strong interest in the Activity monitor ([section 6.6](#)), you can start with
211 calibrating that, and have it run already in the weeks when you go through sections 4 and 5.
212 In case you use an EatingSoonTT at meal start (the author recommends to try without), note that any
213 active TT shuts activity monitor automatically off while that TT is active.

214
215 Resist the temptation to make use of the tools presented in sections 5 and 6 too early.

216 On your **first** setting-up and tuning attempt, **it is strongly recommended that you not “play**
217 **around” with all ultimately available features, but stick to the sequence of steps to take.**

218
219 Yes, “playing around” with the many extra buttons often will help find an improvement. But you
220 likely create an instable FCL that, already at fairly standard situations, uses up some of your FCL's
221 principal capacity to correct for disturbances. This limits what will be left to manage extreme
222 situations.

223
224 Caution: **Once you created a maze of little errors and counter-strategies/counter-errors, it will be**
225 **nearly impossible to find your way** out of this mess, **towards better settings**, at any later point of time.

226
227 Note that it is principally not easy to conclude on suitability of tuning:

- 228 • AutoISF comes with very many (currently 18) extra parameters, and even when employing the
229 emulator ([sections 10](#) and [11](#)), it is quite hard to analyze their interaction.

230 One principal reason why things are difficult to analyze is, that you really can only analyze one
231 decision, and that will put you on another bg curve. So, you can never see the full effect, along more
232 than half an hour or so, that *any* change would really result in.

233

234 • Understandably, many loopers rather “move forward” to an over-patch for identified problems, and
235 not bother with a more “puristic” step-by-step approach to do things right from the ground up.

236 • Aware of above sketched conundrum, the AAPS autoISF developers offer the ultimate tool to
237 investigate “what-if”, regarding a setting change you may contemplate: A nice lady voice on your
238 smartphone can tell you, at each loop decision, where your contemplated change would make a
239 difference (in SMB size). This offers an opportunity to watch closely, with or without implementing
240 that change. (It is always your spontaneous choice, whether you want to “follow the lady’s
241 suggestion and manually add to the SMB, as suggested). More see in [Section 11.4](#)

242 But, we are getting ahead too far here. You first must find a starting point for key settings, which works
243 reasonably for not too-challenging meals in your personal spectrum.

244 Before getting into this, let’s first have a look on how autoISF basically works. (More see in Quick guide by
245 the developer, referenced in [section 3.2](#); or directly at <https://github.com/ga-zelle/autoISF>).

246

247 [4.1.2 autoISF factors overview in typical glucose chart](#)

248

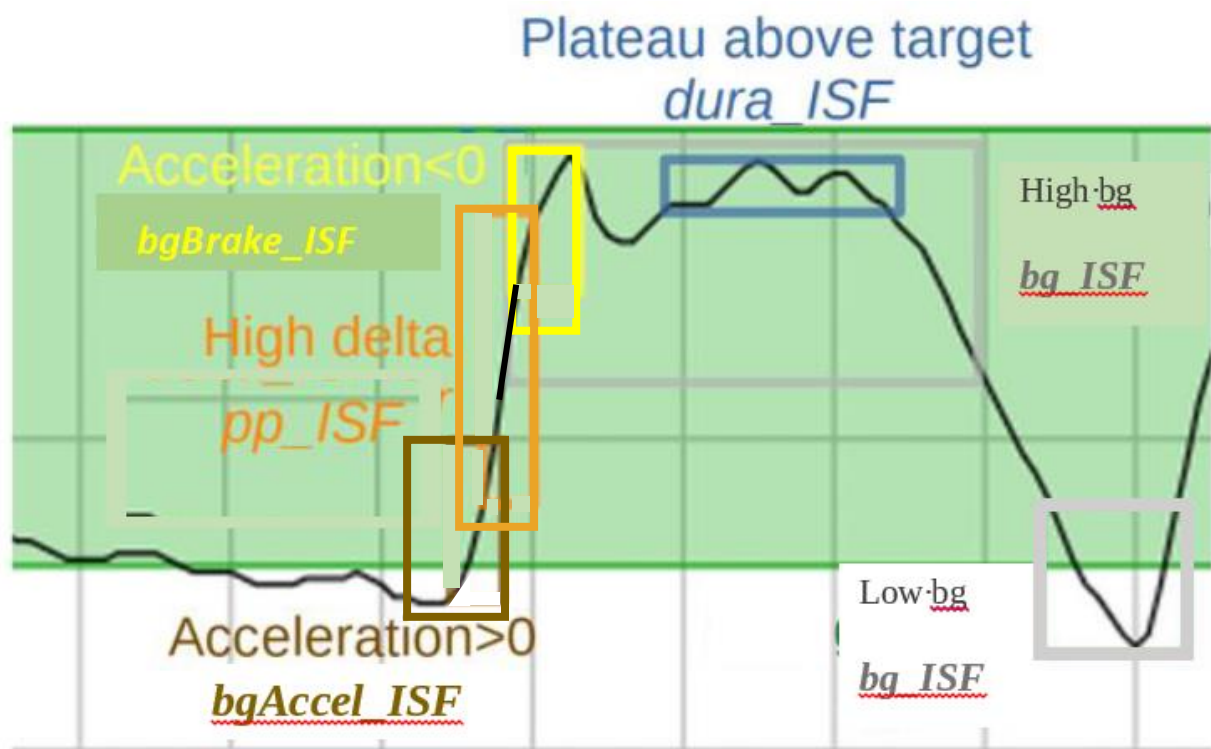
249 The core challenge of your UAM Full Closed Loop is to recognize a meal start from the glucose
250 trend, and ramping up iob.

251

252 When setting up your autoISF Full Closed Loop, **you must set several ISF_weight parameters**
253 **in AAPS Preferences/OpenAPS SMB/autoISF settings.**

254

255 They relate to different stages of the typical glucose curve after starting a meal:



Note: **bg_ISF** is not used much in FCL, as it is rather late to act on high (or low) bg level that developed. But, feel free to experiment, e.g. in case you have indications, in your data, that in the past dynamicISF was useful to manage bg extremes in some situations.

The core advantage of using autoISF withoref(1) SMB+UAM (in FCL as well as in hybrid closed loop) is that it manages the glucose curve it sees developing, **no matter what the underlying reason** is.

42 potential factors were identified (see: <https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings/blob/FCL-w/autoISF/42%20factors%20influence%20bg.pdf>), so, no wonder, that loopers who meticulously input their carbs will often *not* see the expected result.

In case you like to learn more about the theoretical background for the autoISF development, here some core aspects the key developer shared in a DIY forum:

Theory behind autoISF

gazelle, Aug. 2024

I have recently managed to work through the large pile of older (German) diabetes journals. I've now reached issue 5/2024 and was amazed by the article "How insulin is produced and works in the body".

According to the article, there are essentially 2 phases of release:

- Phase (1) lasts only a few minutes and releases a large dose from the beta cell's supply when glucose rises.
- (2) After that, insulin is newly produced and released evenly over a period of hours.

These two phases remind me very much of initial acce_ISF and later dura_ISF in autoISF.

This may explain why it works so well for many users. I had no idea about this process in the body when I developed both effects.

1. acce_ISF was based on **Newton's 2nd law of mechanics**, i.e. inertial mass * acceleration = force.
For me, this meant that when the FC is accelerated, a "sweet force" is acting.
To counteract this, the acceleration must be counteracted.
Strengthening the ISF, i.e. increasing resistance, corresponds to an increase in inertial mass, so to speak.
2. dura_ISF was an analogy to the **PID controller** in technology:
P stands for proportional control, in this case the deviation of the FC from the target value;
I stands for integral of the deviation, in this case the sum of the deviation from the target;
D stands for differential control, in this case the delta of the BG.

The components for P and D are contained in the regular AAPS, but the I component was missing. So I added it, as a rough approximation, using dura_ISF.

*I find it very interesting that both solutions came about from analogies to technology/mechanics without direct knowledge of **hormone metabolism**. I have always been interested in using analogies to transfer solutions to other fields.*

Translated with DeepL.com (free version)

Remark: This just broadbrush sketches the general idea. Lots of dev work had unfortunately to go into details, like how to deal with everyday imperfections of our CGM systems, and still come up with meaningful mathematical (parabola fit) earliest-possible detection of "real" bg rises.

4.1.3 Getting ready to set your autoISF_weights

Before you progress, make sure you studied the flowcharts in [section 3](#) that describe how autoISF calculates the **effective**(ly used) ISF.

Warning: Any bolus you „sneak in“ will severely distort the glucose curve. That could render your tuning of weights (see below) useless, and could **make your loop act in unpredictable ways** (potentially also dangerous, however, your set iobTH ([section 2.4](#)) should help here, too).

In case you feel tempted to use boli, be ready for some own extra research, and refer to [section 7](#).

After doing the prep work as outlined in [section 2](#) you now get to calibrate your FCL to your **normal meal spectrum** by initially **setting and tuning the various _ISF_weights**, that dynamically change with bg curve characteristics as sketched in the chart on the previous page.

Please stay away from extremes (regarding both, meals and exercise) **when you go through this [section 4](#)**. It is about getting a first *roughly right* set of settings, as a basis.

Researching your standard meal patterns, and finding settings for the various _ISF_weights is the core job in setting up your autoISF FCL.

Depending how varied your diet and general lifestyle are (and your expectation of %TIR you like to reach), this could be the main job at hand. However, there is much more you *could* do later, and that will be outlined in later sections 5 and 6.

Consult sometimes your SMB tab, to see how the applied effective ISF (named **sens** there) is calculated. (Example given in [section 5.4.5](#)).

4.2 Meal detection and managing the initial bg rise: bgAccel_ISF

4.2.1 Mimicking a HCL bolus in FCL using bgAccel_ISF

When looping without carb inputs and without giving a bolus ourselves, the first crucial setting is to set the **bgAccel_ISF_weight** so that SMBs are requested immediately when the loop detects an acceleration in your blood glucose (bg) that is starting to rise.

Ideally **within about 20 minutes after acceleration detection, which would be the first up to 4 SMBs, as much iob should automatically be supplied as we would have given with our bolus in hybrid closed loop.**

As the biggest principal challenge for the FCL is big **high/fast carb** meals (from within your personal “spectrum”), we start with a focus to get sufficiently big SMBs going for those.

Note, though, that in a **low carb** meal scenario, the first 4 SMBs would have to automatically result much smaller (which, after careful tuning, is possible with the same parameter settings, see e.g. [case studies 4.2 vs 4.3](#)).

Rule of thumb: Two of the first three SMBs each (in this test based on a big meal) should be about ¼ to 1/3 the size of a bolus in your HCL „career“ (for a similar meal).

Going over 1/3 could be problematic

- if your diet contains occasional **low carb** (or brief **snacking**), it is not helpful if your settings make your loop invariably “bounce” over your iobTH (and then you would need extra snacks to balance the auto-generated iob, to prevent hypos),
- also if your **CGM quality** is sometimes unreliable, and might produce an artefact that could be mistaken for a meal start.

Be vigilant about this topic! And please do not choose the supposedly easy way, to just set safety restrictions (allowed max SMB size, or autoISFmax) so low, that your loop never can exceed 1/3. Try to really tune the _ISF_weights appropriately. (Only that way, your loop can “accommodate” the entire meal spectrum, and also states of adapted general insulin sensitivity).

4.2.2 Widened safety restrictions

Already when tuning the bgAccel_ISF_weight it can become evident that safety restrictions (as discussed in [section 2](#)) must be **widened** further:

- 363 • Especially if your *profile basal* rate is very small, the **smb_max_range_extention** and/or
364 the **autoISF_max** "must" often be increased further.
- 365 • Pay attention also to the **iobTH%** and, potentially, iobMAX
- 366 • Note that the smb_delivery_ratio "only" portions the insulinReq differently over the next 15
367 minutes (see also [section 2.3](#)), and therefore is **not** a prime tuning parameter.

368 In the end you should **not set these safety limits too tight**, so "nudging" aggressiveness by
369 another 10 or 20% from your cockpit, later, will not bounce into restrictions.

370

371 On the other hand, setting **narrower** restrictions for max allowed SMB size can also become
372 necessary:

- 373 • Poorer CGM quality demands narrower restrictions for safety reasons.
- 374 • If you use a 1-minute CGM, please observe [section 1.4.2](#)

375

376 [4.2.3 Start value for your bgAccel_ISF tuning](#)

377

378 bgAccel_ISF_weight is set default to zero in AAPS Preferences/SMB/autoISF.

379 **To start**, I would try 0.05 or **max 0.1**, and keep trying in max 0.05 steps. Soon move to 0.02 steps.
380 From my (very limited) overview, many use around 0.2, and possibly even higher if their hourly
381 basal rate is 0.1U or lower. ([Consult section 4.8 when available](#)). Do not be tempted to rush this
382 setting by using large jumps in adjustments.

383 **To monitor what is happening**, and start tuning, in search of appropriate settings, you must keep
384 (real-time) track of how autoISF uses your set bgAccel_ISF_weight:

385

- 386 • To do this in the **SMB tab** is possible but not very practical. You would end up making a lot
387 of screenshots (quickly in the crucial minutes after a SMB was given, or when *you thought it*
388 *should be* given), for later analysis.
- 389 • The superior method is to just copy **logfiles** from your phone/internal
390 memory/AAPS/logs ...

391 ○ all zip files there

392 ○ look up how many days of data are covered there on a rolling basis, and copy out
393 onto your PC (see [section 10.1.1](#)) before the older ones get forever lost

394 ... and analyze them at your convenience later, using the **emulator** (see [section 10](#); used
395 e.g. in last pages of [case study 4.2](#)).

- 396 • Some emulator-based analysis is also possible within AAPS on your phone ([section-11](#)).

397 In any case, it is worth the effort to tune the **bgAccel_ISF_weight** in such a way that high glucose
398 increases are already nipped in the bud, so to speak.

399

400 To summarize: In FCL, the first 3 or 4 SMBs should not be much delayed, and amount to similar
401 iob like your “former boli in HCL”.

402 Depending on details about the carb absorption characteristics of your meal, and the performance
403 of your CGM, also **pp_ISF** (see 4.3) might be a fairly early contributor to getting iob up.

404

405 4.2.4 How changing the _weights influences the resulting calculated insulinRequired

406 (You can skip reading this section, unless you want to know quantitatively how things work).

407

408 The developers’ documentation (Quick Guide) [https://github.com/ga-](https://github.com/ga-zelle/autolSF/blob/A3.2.0.4_ai3.0.1/autolSF3.0.1_Quick_Guide.pdf)
409 [zelle/autolSF/blob/A3.2.0.4_ai3.0.1/autolSF3.0.1_Quick_Guide.pdf](https://github.com/ga-zelle/autolSF/blob/A3.2.0.4_ai3.0.1/autolSF3.0.1_Quick_Guide.pdf) gives the following equation:

410

411 accelSF is the factor by which autoISF wants to sharpen the profile ISF in a certain
412 situation of bg acceleration:

 acce_ISF is calculated by

$$\text{acce_ISF} = 1 + \text{acce_weight} * \text{fit_share} * \text{cap_weight} * \text{acceleration} \quad (\text{eq.1})$$

where fit_share a measure of fit quality, i.e. 0% if unacceptable up to 100% if perfect;
cap_weight is 0.5 below target and 1.0 otherwise;
acce_weight is bgAccel_ISF_weight for acceleration away from target, i.e. mostly positive
or bgBrake_ISF_weight for acceleration towards target, i.e. mostly negative

413

414 fit_share should be close to 1.0 (if good CGM quality.

415 cap_weight is 1.0 for bg>target

416 Having a EatingSoonTT at first acceleration *can help avoid* the factor **iF** getting cut in half!

417 $\text{profile_ISF} / \text{acce_ISF} = \text{effectively used ISF (sens)}$

418 (...if the acce influence dominates and is used as effective ISF. Else, see flowcharts in Quick Guide)

419

420 When looking at the same acceleration moment, we can combine all three last factors of eq.1 into a term
421 “**iF**”.

422 For estimating the effect from using another ISF_weight, we then have two (eq.1) , with two unknowns, **iF**
423 (“cancelling out”), and the sought acce_ISF (for new _weight).

424

425 **Example:** Your profile_ISF is 40 mg/dl/U. Using bgAccel_ISF_weight of 0.2

426 you saw effectively used ISF of **30.3** mg/dl/U (box C13 in table below) = $40 / 1.32$

427 => factor for acce_ISF = 1.32.

428 For an intended correction by – 10 mg/dl the insulinRequired would calculate to $10 / 30.3 =$
429 0.330 U.

	A	B	C	D	E	F	G	H
1	Profil ISF (mg/dl/U)	40		bgAccel_ISF tuning -				
2	InsReq (U) @ iF=0	1		see FCL e-Book section 4.2.4				
3	bgAccel_ISF_weight	0,2			0,1			InsReq effect
4	iF	acce ISF old	ISF old	InsReq old	acce ISF new	ISF new	InsReq new	
5	0	1	40	1	1	40	1	0%
6	0,2	1,04	38,5	1,04	1,02	39,2	1,02	-2%
7	0,4	1,08	37,0	1,08	1,04	38,5	1,04	-4%
8	0,6	1,12	35,7	1,12	1,06	37,7	1,06	-5%
9	0,8	1,16	34,5	1,16	1,08	37,0	1,08	-7%
10	1	1,2	33,3	1,2	1,1	36,4	1,1	-8%
11	1,2	1,24	32,3	1,24	1,12	35,7	1,12	-10%
12	1,4	1,28	31,3	1,28	1,14	35,1	1,14	-11%
13	1,6	1,32	30,3	1,32	1,16	34,5	1,16	-12%
14	1,8	1,36	29,4	1,36	1,18	33,9	1,18	-13%
15	2	1,4	28,6	1,4	1,2	33,3	1,2	-14%
16	2,2	1,44	27,8	1,44	1,22	32,8	1,22	-15%
17	2,4	1,48	27,0	1,48	1,24	32,3	1,24	-16%
18	2,6	1,52	26,3	1,52	1,26	31,7	1,26	-17%
19	2,8	1,56	25,6	1,56	1,28	31,3	1,28	-18%
20	3	1,6	25,0	1,6	1,3	30,8	1,3	-19%
21	3,2	1,64	24,4	1,64	1,32	30,3	1,32	-20%
22	3,4	1,68	23,8	1,68	1,34	29,9	1,34	-20%
23	3,6	1,72	23,3	1,72	1,36	29,4	1,36	-21%
24	3,8	1,76	22,7	1,76	1,38	29,0	1,38	-22%
25	4	1,8	22,2	1,8	1,4	28,6	1,4	-22%
26	4,2	1,84	21,7	1,84	1,42	28,2	1,42	-23%
27	4,4	1,88	21,3	1,88	1,44	27,8	1,44	-23%
28	4,6	1,92	20,8	1,92	1,46	27,4	1,46	-24%
29	4,8	1,96	20,4	1,96	1,48	27,0	1,48	-24%
30	5	2	20	2	1,5	26,7	1,5	-25%

Now, going with a 50% reduced bgAccel_ISF_weight of 0.10:

$$\text{acce_ISF} = 1 + \text{bgAccel_ISF_weight} * \text{internalFactor}$$

before $1,32 = 1 + 0,20 * iF \Rightarrow 0,32 = 0,20 * iF \Rightarrow iF = 1,60$ (see box A13)

after $? = 1 + 0,10 * iF \Rightarrow ? = 1 + 0,10 * 1,6 = 1,16$

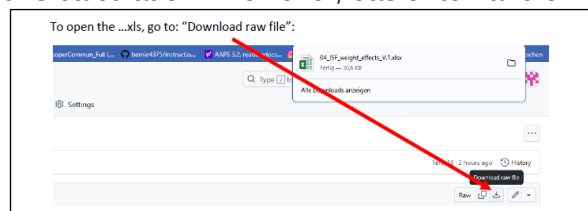
New effective ISF would be $40 / 1,16 = 34,48$ mg/dl/U (box F13).

For an intended correction by – 10 mg/dl the **insulinRequired** would now calculate to $10 / 34,48 = 0,290$ U, which is **12 % less** (H13).

At higher acceleration points of the bg curve (column A, line 14 and higher), the effects would be more pronounced (column H, line 14 and higher).

An **Excel tool** is provided in e-book section 04 for this calculation. However, easier to handle might be the:

Simple “trial and error” approach



To get a feel for how changing the _weights influences the resulting calculated insulinRequired, it is best to start cautiously and **just do 10 to max 20% steps up, and watch out for the effects.**

Doing similar step sizes should yield about similar effects each time.

Never forget to look into how other .._ISFs play into the effective ISF (named **sens** in the SMB tab), which overall results.

4.2.5 Characteristics of a well tuned-in bgAccel_ISF_weight

453

454 Your starting point was to set the bgAccel_ISF_weight so FCL works in a rather high carb meal.

455

456 Now you must check (and potentially fine tune) so it **will not “shoot iob too high”** with the first 3

457 or 4 SMBs **in other meals from your spectrum:**

458

- 459 • For meals that are in the **lower** (!) range of the “fast **carb load**” of your cluster, the
460 necessary insulin supply for the first two hours or so might pretty much be provided already
461 with the first 3 or 4 SMBs

462 The glucose curve, at such meals, begins to flatten early in this SMB phase, so a de-

463 celeration (**braking**) follows very soon (-> [section 4.4](#)). Clearly, the first 3 SMBs, in such

464 cases, must remain below iobTH.

- 465 • **Low carb** meals are principally easiest for the FCL. However, you must secure that your
466 bgAccel_ISF driven **first SMBs** remain small. This is principally possible also with a fairly
467 aggressive bgAccel_ISF_weight set, because both acceleration and initial deltas are small
468 when eating low carb. (Regarding the detected acceleration, the stakes may be high for the
469 CGM and smoothing method you chose).

- 470 • A stage where moderate amounts of carb absorption and of insulin usage/need hold a
471 balance could protract – at moderate bg elevation -over hours. The **dura_ISF** might play a
472 bigger role, then, as e.g. in the low carb example in [case study 4.2](#).

473

474 In case you run into limitations, see next sub-chapter.

475

4.2.6 Suitability for many types of meal

477

478 For a **hands-off FCL**, your settings have to fit

- 479 • **in each** of your **meal times**

480 What helps here is that, *between* your daily mealtime slots, your **circadian profile ISFs**

481 (upon which the autoISF modulations build) automatically make a differentiation (as was
482 the case in your HCL).

- 483 • for the whole **range of your meals**. All this is principally possible, but: ...

484 [What if you still have meals that you cannot make fit?](#)

485

486 In extreme cases you will have to balance too high running iob with additional carbs (a late
487 additional snack against going too low), and in the opposite case, you will have to reckon with
488 temporarily exceeding the glucose target range, and losing some %TIR for this day.

489

490 If your meals vary very strongly, there are **avenues to ease your initial tuning job, or to**
491 **optimize overall resulting loop performance:**

- 492 • Automations allow you to differentiate. For instance it is possible to apply different
493 iobTH_percent and/or different bgAccel_ISF_weights for meals in different **time windows**
494 or geo locations (details see [sections 3.4](#) and [5.1](#))

495 In case you use autoISF on the Trio or iAPS platform for i-phones, you may need to use a
496 third party automation software, or “middleware“ (! [call for a case study 4.X](#))

- 497 • you can pre-program **custom buttons for special meal (or snack) types**, with different
498 underlying FCL settings (see “cockpit”, [section 5.2.2.3](#))
- 499 • You can **modulate FCL aggressiveness manually** making use of the top 3 buttons in the
500 AAPS home screen: These turn yellow during temporary switched %profile or glucose
501 target ([section 5.2.2.2](#))

502

503 Experimenting with the three above mentioned “avenues”, the author found:

- 504 • the last point easiest to occasionally use, and the first one hardest.
- 505 • it worth investing some effort (also using the emulator a couple of times) to iterate through
506 the typical meal spectrum a couple of times, for finding a “good enough” set
507 of .._ISF_weights and other settings (like autoISFmax, iobTH% etc), **and not do much**
508 **extra differentiation**. (More see in [section 5](#)).

509

510 [4.2.7 Summary on tuning for the initial SMBs via bgAccel_ISF](#)

511

512 **Early strong iob** also will **ease the tuning task for the subsequent phases** of the meal, because
513 there is, then, largely zero-tempering (as well known from HCL-times after your administered bolus).
514 Also, the lower and shorter lasting the glucose peak, the lesser the hypo danger from the activity
515 tail of SMBs given *when* glucose was „stuck“ high.

516 However, it is important **not too super-aggressively** tune bgAccel_ISF_weight up, so, regardless
517 of the type of meal, very big SMBs invariably would result.

518 Rather, the rough idea should be:

- 519 • SMBs driven by bgAccel_ISF: initial iob for **all meals**. SMB sizes vary, because accelerations
520 and deltas vary.

521 So, at high carb meals it depends on your settings, and on the evolving bg curve, whether the
522 first few bgAccel_ISF driven SMBs get you already up to iobTH in high carb meals, or whether
523 this happens in the *overlapping* next stage.

524 So, looking a bit ahead to the next chapters:

- 525 • SMBs driven by pp_ISF: to the extent there is strong (near-linear) bg rise (at **big meals rich in**
526 **carbs**) with big or small deltas, iob is now driven towards (and potentially over) iobTH.

527 In low carb meals this period can be extremely short, with iob remaining under iobTH (example
528 see [case study 4.2](#))

- 529 • SMBs driven by bgBrake_ISF, bg_ISF, or dura_ISF:

530 Note that *all of these* can overlap with the pp_ISF stage. Consult the csv table output
531 from the Emulator (example given at end of [case study 4.2](#)) as to which of the _ISF
532 categories drives the effectively used ISF (and what change of the ..._ISF_weights
533 would change this. Consult decision flowcharts for effective_ISF in pages 1-6 of the
534 Quick Guide.pdf in <https://github.com/ga-zelle/autolSF>).

535 Depending on the shape of the bg curve after the initial strong rise, and depending on
536 insulinReq. and on iob (> iobTH?), autolSF can provide more SMBs to bring bg to target. This
537 case applies to **low carb** meals. The dura_ISF is also useful to manage temporary insulin
538 resistance often observed late in **fatty** meals.

539

540 **It is worth investing effort** (following the sequence of steps in sections 01-04 of this FCL e-book)
541 **in your initial project to establish a good set of ISF_weights** for your meal spectrum. This will
542 keep interventions in daily life to a minimum.

543 Unless your lifestyle, or health and body weight change radically, this should be **a one-time effort**
544 (in your initial weeks establishing your FCL), with *no need* to fine-tune much later (see [section 8](#)).

545

546 4.2.8 Note regarding acceleration “happening again” in late part of [dropping](#) glucose

547 (*Skip, unless interested*)

548 After the peak, in the late stage of *falling* bg, the glucose curve is like an accelerating
549 parabola again. The algorithm tries to evaluate when and at which bg level complete
550 digestion of the meal and a bg minimum will result. Insulin required to stabilize around
551 target bg is usually very small, and the adaptation of ISF in that stage relatively
552 unimportant. See in your SMB tab, how, at “already falling” bg, the ISF modulation is taken
553 back.

In version 2.2.8.2 there was a potential deficiency in situations where glucose was falling and the glucose acceleration was already positive. That meant a minimum glucose level can be extrapolated. If that happens to be less than target and expected in less than 15 minutes then there should be no strengthening of ISF as it would lower glucose even more. Therefore bgBrake_ISF_weight is used now instead of bgAccel_ISF_weight. But those situations were rare and less critical than might be expected at first sight. The reason is that in most cases the predictions ended up even below their threshold meaning SMB were disabled.

4.3 Managing strong bg rises: pp_ISF

4.3.1 Main function of pp_ISF in autoISF FCL

In the later phase of acceleration and in the earlier phase of deceleration there is a more or less linear increase of bg with **high deltas**, and corresponding extra insulin need.

- With **higher carb load** meals, or meals that come with a sweet drink, the increase will be particularly strong, and (if not already driven there by bgAccel_ISF) now reach, and with the last “allowed” SMB exceed, the valid iobTH.
- With **low carb** meals, there is only a very un-pronounced (short, with weak deltas) “pp_ISF phase”. (Example see end of [case study 4.2](#)).

autoISF should now “fight” this with the help of the post-prandial ISF, set via **pp_ISF_weight**, after you have set your bgAccel_ISF_weight.

4.3.2 Tuning pp_ISF_weight

To tune-in your **pp_ISF_weight**, please do this with a really high carb meal (from within your typical meal spectrum) *after* you have set a halfway suitable (not too aggressive) bgAccel_ISF_weight.

Note that if you rush into pp_ISF tuning while “still having a too aggressive bgAccel_ISF”, the latter is covering up the requirement you now really want to calibrate for in pp_ISF!

So, at a meal in the upper spectrum of your carb load, carefully begin with a starting value for *pp_ISF_weight* of 0.005. Observe the reactions and check the SMB-tab before you increase it cautiously for the next days.

Best practice is to analyze the emulator tables (discussed in [section 10](#), and example given in the pizza [case study 4.1](#))

585 How changing the `_weight` influences the resulting calculated `insulinRequired`

586 (You can continue 2 pages down at 4.3.3, unless you want to know quantitatively how things work).

587

588 The developers' documentation (Quick Guide, page 5) <https://github.com/ga->

589 [zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf](https://github.com/ga-zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf) gives the following equation:

$$\text{pp_ISF} = 1 + \text{delta} * \text{pp_ISF_weight.} \quad (\text{eq. 2})$$

590

591 `profile_ISF / pp_ISF = effectively used ISF (sens)`

592 (...if the pp influence dominates, and is used as effective ISF. Else, see flowcharts in Quick Guide)

593

594 **Note** that the `pp_ISF` effect only comes in when there is positive `short_avg_delta`, AND `bg`
595 is minimum 10 mg/dl **above** `bg_target` already.

596 • Before, we need `bgAccel_ISF` do its job!

597 • Evidently, by setting a lowTT around meal start, you can influence (not the size, but)
598 *how soon `pp_ISF` will “compete with” your `bgAccel_ISF`* (... and this can play out
599 very differently, at different kinds of meal, too.)

600

601 Tuning: When looking at the same moment (same delta), the effect from using *another* `ISF_weight`,
602 can be mathematically be solved with two (eq.2):

603

604 **Example:** Your `profile_ISF` is 40 mg/dl/U. Using `dura_ISF_weight` of 0.02 you saw

605 effectively used ISF of 30.3 mg/dl/U (box C13 in table below) = $40 / 1.32$

606 => factor for `pp_ISF` = 1.32.

607 For an intended correction by – 10 mg/dl the `insulinRequired` would calculate to $10 / 30.3 =$
608 0.330 U.

	A	B	C	D	E	F	G	H
1	profile.ISF (mg/dl/U)	40		pp_ISF tuning -				
2	InsReq (U) @delta=0	1		see FCL e-Book section 4.3.2				
3	pp ISF weight	0,02			0,03			InsReq effect
4	delta (mg/dl)	pp ISF_old	ISF_old	InsReq_old	pp ISF_new	ISF_new	InsReq_new	
5	0	1	40	1	1	40	1	0%
6	2	1,04	38,5	1,04	1,06	37,7	1,06	2%
7	4	1,08	37,0	1,08	1,12	35,7	1,12	4%
8	6	1,12	35,7	1,12	1,18	33,9	1,18	5%
9	8	1,16	34,5	1,16	1,24	32,3	1,24	7%
10	10	1,2	33,3	1,2	1,3	30,8	1,3	8%
11	12	1,24	32,3	1,24	1,36	29,4	1,36	10%
12	14	1,28	31,3	1,28	1,42	28,2	1,42	11%
13	16	1,32	30,3	1,32	1,48	27,0	1,48	12%
14	18	1,36	29,4	1,36	1,54	26,0	1,54	13%
15	20	1,4	28,6	1,4	1,6	25,0	1,6	14%
16	22	1,44	27,8	1,44	1,66	24,1	1,66	15%
17	24	1,48	27,0	1,48	1,72	23,3	1,72	16%
18	26	1,52	26,3	1,52	1,78	22,5	1,78	17%
19	28	1,56	25,6	1,56	1,84	21,7	1,84	18%
20	30	1,6	25,0	1,6	1,9	21,1	1,9	19%

Now, going with a 50% stronger pp_ISF_weight of 0.03 (table: E3):

$$\text{pp_ISF} = 1 + \text{delta} * \text{pp_ISF_weight}$$

before $1,32 = 1 + 0.02 * \text{delta} \Rightarrow 0,32 = 0.02 * \text{delta} \Rightarrow \text{delta} = 16 \text{ mg/dl}$

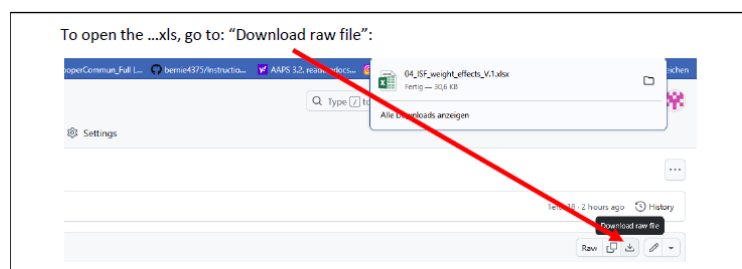
after $? = 1 + 0.03 * \text{delta} \Rightarrow ? = 1 + 0.03 * 16 = 1.48$

New effective ISF would be $40 / 1.48 = 27.03 \text{ mg/dl/U}$ (box F13 in table).

For an intended correction by – 10 mg/dl the insulinRequired would now calculate to $10 / 27.03 = 0.370 \text{ U}$, which is 12.1 % more insulin (box H13 in table).

The % effect would be more or also less pronounced, depending how strong bg is rising (delta), which is of course the key idea behind pp_ISF.

An Excel tool is provided in e-book section 04 (Github/bernie4375) for this calculation. However, a simple “trial and error” approach as outlined initially in this 4.3.2 section (2 pages before) might be easier to handle.



To summarize, tuning-in the pp_ISF_weight allows the user to define her/his personal sweet spot for ISF aggressiveness in the phase of strongly rising bg.

- As different kinds of meals will have different delta patterns, it can well be that one pp_ISF_weight (as set by you in AAPS preferences) is good for all meals.
- Note that a circadian profileISF provides an avenue to still differentiate between e.g. breakfast and lunch response of your autoISF loop.

635 4.3.3 Loop states with very little insulin need ($iob > iobTH$, or 0 %TBR)

636

637 Normally (except for very low carb meals) the SMBs triggered by `bgAccel_ISF_weight` and
638 `pp_ISF_weight` should be sufficient to reach and slightly exceed the **iobTH** (see [section 2.4](#)) so all
639 *the other* autoISF parameters are relatively unimportant for now.

640

641 A reason why this can work at all, also for quite a variety of meals, lies in the fact that there
642 is an hourly carb absorption limit of about 30g/h

643 (Reference: Dana

644 Lewis: [https://github.com/danamlewis/artificialpancreasbook/blob/master/8.-tips-and-tricks-](https://github.com/danamlewis/artificialpancreasbook/blob/master/8.-tips-and-tricks-for-real-life-with-an-aps.md#heres-the-detailed-explanation-of-what-we-learned)
645 [for-real-life-with-an-aps.md#heres-the-detailed-explanation-of-what-we-learned](https://github.com/danamlewis/artificialpancreasbook/blob/master/8.-tips-and-tricks-for-real-life-with-an-aps.md#heres-the-detailed-explanation-of-what-we-learned). (That limit

646 can be lower, e.g. with gastroparesis or certain medications, but that would make things
647 even easier)

648

649 So while meals might wildly vary in composition and size: What is digested, and needs insulin in
650 the first ~90 minutes (when FCL tries to catch up with insulin need and differs strongly from HCL,
651 with `bgAccel_ISF` and `pp_ISF` in the leading role), will be relatively close...for meals with similar
652 *initial* glucose acceleration and rises, anyways...

653

654 The others, **low carb** with much slower initial acceleration and rise, are easily recognized as
655 different by the loop, see [section 4.4](#) that follows.

656

657 Depending on the type of meal and "aggressiveness" of your `bgAccel_ISF_weight` and
658 `pp_ISF_weight` tuning, the *iob* will already be so high that, in the phase of decelerated glucose rise
659 towards the peak (the "last part of the rise"), no more `insulinRequired` is seen by the loop.

660

661 Therefore the **bgBrake_ISF_weight** is often unimportant in meals with a relevant carb content.

662 For potential relevance in low carb meals, see [section 4.4](#).

663

664

665 4.3.4 "Quality control" on how well your tuning can replace your former HCL bolussing

666

667 Warning: **Occasionally consult the SMB tab to see how your settings really work.**

668 A setting (...ISF_weight) that is actually set too aggressive might be masked.

669 **Tuning only works if** the effects of the settings being tuned are **not** unintentionally **limited by**
670 **other** (e.g. „safety“) **settings**.

671

672 Also, **always look at two or three *different* meals** before deciding whether a tuning "fits" („good
673 enough“ for each of them). You probably will have to iterate back and forth doing this for two or
674 three different kinds of meals ...

- 675 • [Case Study 4.1](#) (Pizza Meal) contains, towards the end, an example how you can go about
676 tuning the `_weights` for various `_ISF` factors of `autoISF`.
- 677 • [Case Study 8.2](#) shows that it is **not** worth it to seek “optimized” settings based on just one
678 (more extreme) meal.

679 ... until you find *one* good enough set of settings *for all* of them. Do not rush this, establishing a
680 solid foundation will be well worth your time.

681
682 **The following sections will deal with similar issues like you were facing in HCL after your**
683 **given bolus lost much of its power, and SMBs were needed for the “eCarbs”.**

684 685 4.4 Sluggish rise towards a bg peak: `bgBrake_ISF`

686
687 At a **low carb** meal, or an attempt at doing a **weight reduction diet**, (and probably also with
688 gastroparesis, or if you take one of these novel GLP-1 drugs that slow meal absorption -
689 **Somebody, please supply a case study!**)- the glucose goes up only sluggishly, and `iobTH` should
690 not be reached at all.

691 In case you *exclusively* do very slow absorbing meals, you could of course also adjust your `iobTH`
692 setting low enough to suit your *uniform* situation.

693
694 Acceleration, and the phase of strong glucose rise, are quickly over at slow-absorbing meals, and
695 there can be:

- 696 • a decelerating bulge of insulin action that projects over an hour or longer. This is where the
697 importance of the **`bgBrake_ISF`** can come in.
- 698 • a bg curve that hovers for an hour or longer around an elevated bg level, because
699 additionally absorbed carbs, and consumption of the moderate SMBs delivered, tend to
700 keep a balance for a while. **`Dura_ISF`** can deal with this (see next chapter). An example for
701 this is given in [Case study 4.2](#).

702 Note that in some data outputs (e.g. the csv/xls tables coming from the Emulator, e.g. in Case study 4.2,
703 big table at the end there), you will see only “**`acce_ISF`**” results.

- 704 • In case of positive acceleration, these are driven by the `bgAccel_ISF_weight` setting, and results
705 are >1 .
- 706 • In case of negative acceleration (decelerating rise), **`bgBrake_ISF_weight` is applied**, , and
707 results are <1 . (Example see in graph in [section 10.3.3.3](#)).

708

709 In full closed loop, the bgBrake_ISF_weight is often only about half as large as the
710 bgAccel_ISF_weight (but that would also depend on your personal diet pattern and
711 eating/digestion speed). Also here, one should approach the tuning gradually, increasing the
712 weight coming from small values.

713

714 Please observe that **tuning bgBrake_ISF_weight must strictly be done with types of meals for**
715 **which there is insulin need at de-celerating but still rising bg.**

716 bgBrake_ISF is totally irrelevant for hi carb meals where your loop shot over iobTH already
717 by the time your rising towards the bg peak slows down!

718 Likewise, if your initial bgAccel_weight is set so strong that your first SMBs catapult you
719 over the iobTH, no matter what type of meal: Then you must **first** find a reasonable setting
720 for this parameter, one that works “good enough” to control your carb loaded meals, and
721 then see whether there is “room” (and need) for milder loop response at low carb meals.

722

723 In case you cannot quite get all the ISF_weights “right” so the occasional low carb meal will not get
724 over-treated: Avenues to adapt your loop aggressiveness are discussed in [section 5](#).

725 For instance you will be able to (if needed):

726

- 727 • use a temp. reduced %profile
- 728 • temp. lower iobTH or bgAccel_ISF_weight
- 729 • construct for yourself a “DIY cockpit” with an extra “snack” or “low carb” button with an
730 underlying suitable Automation

731

732 In the **late stage of still rising (!) glucose**, the Full Closed Loop typically sharply reduces
733 SMBs already because it is “painfully aware” of the following principal conflict:

734

- 735 • iob (like formerly given in HCL via your bolus) must go high quickly, in order to limit the high
- 736 • However, if there is too much insulin in the system, a **hypoglycemia can happen later**
737 within the DIA time window, because the loop can, later, only correct to a very limited extent
738 (namely, only to the extent that it can set basal to zero).

739 Therefore, the core problem is that the Full Closed Loop must build up iob very quickly, **but**
740 **not too much**, in the initial phase of a meal, and high bg values (out of range, >180 mg/dl)
741 can not always be avoided.

742

743

4.5 Sluggish rise into a bg plateau, or late plateauing at high bg: dura_ISF and bg_ISF

Depending how your personal diet spectrum looks, you need to tune-in your dura_ISF primarily with large hi-FPU meals, and/or for meals at the low carb end of your diet

4.5.1 dura_ISF for sluggish rise into a bg plateau

A (in that case, often not very high) plateau can form in **low carb meals**, when, basically, carb and insulin “burn rates” might keep a balance over an hour or longer, requiring occasional moderate size SMBs.(See an example in [case study 4.2](#))

4.5.2 dura_ISF for late/high bg plateaus

With **large or high fat/protein meals**, often a long high bg plateau is encountered (sometimes associated with 2nd “late, long stretched hill” forming for this, in the bg curve). For such situations, autoISF features the modulation of ISF depending on bg level and on duration of **plateau** formation.

4.5.3 “One size fits all” -dura_ISF

Absolute “pros” could primarily calibrate their dura_ISF for low carb.

Dura_ISF has in-built amplification at higher bg levels. So, effects will automatically be boosted in case much higher plateaus develop after greasy feasts.

Should that not per se be sufficient, there is more the DIY “pro” can do:

- by adding an Automation that gives an extra boost “against” the temporary insulin resistance associated with fats (via increasing the baseline, in terms of a temp.130% profile switch, for instance. Compare at: <https://androidaps.readthedocs.io/en/latest/Usage/FullClosedLoop.html#stagnation-at-high-bg-values>),
- or by making additional use of the bg_ISF (or dynamicISF) (-> Tune it in parallel.)

The author’s preference would be to go via Automation, but only in case the in-built differentiation via bg level make it necessary.

782 4.5.4 Options to limit iob delivered from dura_ISF

783

784 Rather than relying on your initial tuning to keep you safe from hypos also in the future, there are
785 some extra precautions you could take. Some were discussed in Discord [or in dev circles](#),
786 regarding what could be done:

787

- 788 1) To limit the danger of going low, it can make sense to
789 design an **Automation** which pauses the delivery of more
790 insulin.

791

This one was suggested by Alex999

792

793

794 If a glucose plateau built under 140 mg/dl, do not treat via
795 dura_ISF (because the defined Action is to set an elevated
796 TT to a level that will not require more correction insulin.

797

An alternative Action would be to set, near the actual
798 glucose target, an odd-numbered TT (which blocks any
799 SMB be given, while valid).

800

801

- 802 2) In an autoISF update, the **duration** in which iob is added up could be **capped** after max. 1.5
803 hours of any “stubborn high”.

- 804 3) Instead of 2), or additionally, the total **iob accrued in that “dura phase” could be capped** by
805 a new related safety setting. It would probably be anchored on iobTH, and could also become a
806 tuneable setting, maybe even a new parameter useable in Automations, too.

807

808 4.5.5 How dura_ISF works

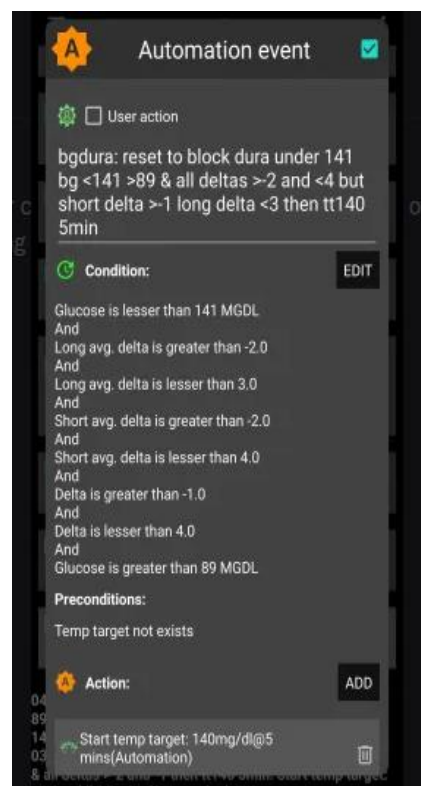
809

810 Conditions for dura_ISF to become active:

- 811 1) Glucose plateaus, i.e. it is varying within a +/- 5% interval only, and this situation lasted at
812 least for the last 10 minutes => Duration **dura_05** = 10 or more minutes.
- 813 2) The average glucose value in this “duration” time window is **avg05** mg/dl. Its elevation rela-
814 tive to bg target determines one of the factors in the equation (eq.3) for dura_ISF, see be-
815 low.

816 Effect:

- 817 • The strengthening of ISF is stronger **the longer** the situation lasts, and **the higher** the av-
818 erage glucose is above target:



- 3) This can be individually tuned by the **duraISF_weight** to automatically manage high plateaus in bg values.

How changing the _weight influences the resulting calculated insulinRequired

(You can continue 3 pages down at 4.5.6, unless you want to know quantitatively how things work).

The developers' documentation (Quick Guide, page 6) https://github.com/ga-zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf gives the following equation:

$$\text{dura_ISF} = 1 + \frac{\text{avg05-target_bg}}{\text{target_bg}} * \frac{\text{dura05}}{60} * \text{dura_ISF_weight} \quad (\text{eq. 3})$$

$$\text{profile_ISF} / \text{dura_ISF} = \text{effectively used ISF (sens)}$$

(...if the dura influence dominates, and is used as effective ISF. Else, see flowcharts in Quick Guide)

When looking at the same moment, we can combine the first two factors of eq.3 (which vary with bg elevation above bg target, and with how long the plateau already shows) into a term "**iF**".

For estimating the effect from using another ISF_weight, we then have two (eq.3), with two unknowns, **iF** ("cancelling out"), and the sought dura_ISF (that results for the new _weight).

Example: Your profile_ISF is 40 mg/dl/U.

Using dura_ISF_weight of 0.6 you saw effectively used ISF of **30.3** mg/dl/U (box C21 in table on next page) = $40 / 1.32 \Rightarrow$ factor for dura_ISF = 1.32.

For an intended correction by – 10 mg/dl the insulinRequired would calculate to $10 / 30.3 = 0.330$ U.

Now, going with a **33% stronger** dura_ISF_weight of 0.80 (box E3):

$$\text{dura_ISF} = 1 + \text{internalFactor} * \text{dura_ISF_weight} *$$

$$\text{before} \quad 1.32 = 1 + 0.60 * \text{iF} \Rightarrow 0.32 = 0.60 * \text{iF} \Rightarrow \text{iF} = 0.533$$

$$\text{after} \quad ? = 1 + 0.80 * \text{iF} \Rightarrow ? = 1 + 0.80 * 0.533 = 1.426$$

New effective ISF would be $40 / 1.426 = 28.04$ mg/dl/U (F21 in table).

For an intended correction by – 10 mg/dl the **insulinRequired** would now calculate to $10 / 28.04 = 0.357$ U, which is **8.1 % more** insulin (H21 in table next page).

	A	B	C	D	E	F	G	H
1	Profil ISF	40		dura_ISF tuning -				
2	InsReq be	1		see FCL e-Book section 4.5.5				
3	dura_ISF	0,6		0,8				InsReq d
4	iF	dura_ISF_old	ISF_old	InsReq_old	dura_ISF_new	ISF_new	InsReq_new	
5	0	1	40	1	1	40	1	0,0%
6	0,033	1,020	39,2	1,027	39,0	1,027	39,0	0,7%
7	0,067	1,040	38,5	1,040	1,053	38,0	1,053	1,3%
8	0,100	1,060	37,7	1,060	1,080	37,0	1,080	1,9%
9	0,133	1,080	37,0	1,080	1,107	36,1	1,107	2,5%
10	0,167	1,100	36,4	1,100	1,133	35,3	1,133	3,0%
11	0,200	1,120	35,7	1,120	1,160	34,5	1,160	3,6%
12	0,233	1,140	35,1	1,140	1,187	33,7	1,187	4,1%
13	0,266	1,160	34,5	1,160	1,213	33,0	1,213	4,6%
14	0,300	1,180	33,9	1,180	1,240	32,3	1,240	5,1%
15	0,333	1,200	33,3	1,200	1,266	31,6	1,266	5,6%
16	0,366	1,220	32,8	1,220	1,293	30,9	1,293	6,0%
17	0,400	1,240	32,3	1,240	1,320	30,3	1,320	6,4%
18	0,433	1,260	31,8	1,260	1,346	29,7	1,346	6,9%
19	0,466	1,280	31,3	1,280	1,373	29,1	1,373	7,3%
20	0,500	1,300	30,8	1,300	1,400	28,6	1,400	7,7%
21	0,533	1,320	30,3	1,320	1,426	28,0	1,426	8,1%
22	0,566	1,340	29,9	1,340	1,453	27,5	1,453	8,5%
23	0,599	1,360	29,4	1,360	1,480	27,0	1,480	8,8%
24	0,633	1,380	29,0	1,380	1,506	26,6	1,506	9,2%
25	0,666	1,400	28,6	1,400	1,533	26,1	1,533	9,5%
26	0,699	1,420	28,2	1,420	1,559	25,6	1,559	9,9%
27	0,733	1,440	27,8	1,440	1,586	25,2	1,586	10,2%
28	0,766	1,460	27,4	1,460	1,613	24,8	1,613	10,5%
29	0,799	1,480	27,0	1,480	1,639	24,4	1,639	10,8%
30	0,833	1,500	26,7	1,500	1,666	24,0	1,666	11,1%
31	0,866	1,519	26,3	1,519	1,693	23,6	1,693	11,4%
32	0,899	1,539	26,0	1,539	1,719	23,3	1,719	11,7%
33	0,932	1,559	25,6	1,559	1,746	22,9	1,746	12,0%

	A	B	C	D	E	F	G	H
34	0,966	1,579	25,3	1,579	1,773	22,6	1,773	12,2%
35	0,999	1,599	25,0	1,599	1,799	22,2	1,799	12,5%
36	1,032	1,619	24,7	1,619	1,826	21,9	1,826	12,7%
37	1,066	1,639	24,4	1,639	1,853	21,6	1,853	13,0%
38	1,099	1,659	24,1	1,659	1,879	21,3	1,879	13,2%
39	1,132	1,679	23,8	1,679	1,906	21,0	1,906	13,5%
40	1,166	1,699	23,5	1,699	1,932	20,7	1,932	13,7%
41	1,199	1,719	23,3	1,719	1,959	20,4	1,959	13,9%
42	1,232	1,739	23,0	1,739	1,986	20,1	1,986	14,2%
43	1,265	1,759	22,7	1,759	2,012	19,9	2,012	14,4%
44	1,300	1,780	22,5	1,780	2,040	19,6	2,040	14,6%
45	1,40	1,840	21,7	1,840	2,120	18,9	2,120	15,2%
46	1,50	1,900	21,1	1,900	2,200	18,2	2,200	15,8%
47	1,60	1,960	20,4	1,960	2,280	17,5	2,280	16,3%
48	1,70	2,020	19,8	2,020	2,360	16,9	2,360	16,8%
49	1,80	2,080	19,2	2,080	2,440	16,4	2,440	17,3%
50	1,90	2,140	18,7	2,140	2,520	15,9	2,520	17,8%
51	2,00	2,200	18,2	2,200	2,600	15,4	2,600	18,2%
52	2,10	2,260	17,7	2,260	2,680	14,9	2,680	18,6%
53	2,20	2,320	17,2	2,320	2,760	14,5	2,760	19,0%
54	2,30	2,380	16,8	2,380	2,840	14,1	2,840	19,3%
55	2,40	2,440	16,4	2,440	2,920	13,7	2,920	19,7%
56	2,50	2,500	16,0	2,500	3,000	13,3	3,000	20,0%
57	3,0	2,800	14,3	2,800	3,400	11,8	3,400	21,4%
58	3,5	3,100	12,9	3,100	3,800	10,5	3,800	22,6%
59	4,0	3,400	11,8	3,400	4,200	9,5	4,200	23,5%
60	4,5	3,700	10,8	3,700	4,600	8,7	4,600	24,3%
61	5,0	4,000	10,0	4,000	5,000	8,0	5,000	25,0%

854

855

856

857 The effects could be more or also less pronounced because the **iF factor** strongly depends (as in
858 eq.3, see also table on next page) on:

859 • how high bg is above target (**avg05**)..

860 • ...and for how many minutes (**dura05**).

861 • Also, do not under-estimate the effect of a low **target_bg**. Not sure you should, but
862 certainly *you could* add an extra boost from that via an Automation that kicks in a low TT (at
863 the “dura situation” that you describe as a triggering condition in your related Automation):

864 **Example:** You plateau at 180 mg/dl and your bg target is 100. The first factor in your iF term
865 then is $(180-100)/100 = 0.80$.

866 Now, with a TT = 74 mg/dl, that term becomes $(180 - 74)/74 = 1.43$

867 (The resulting + 79% in your boost factor does not translate into 79% more insulin - just as
868 we have seen “only” 8% more insulin with a 33% boost in the complete example before).

869

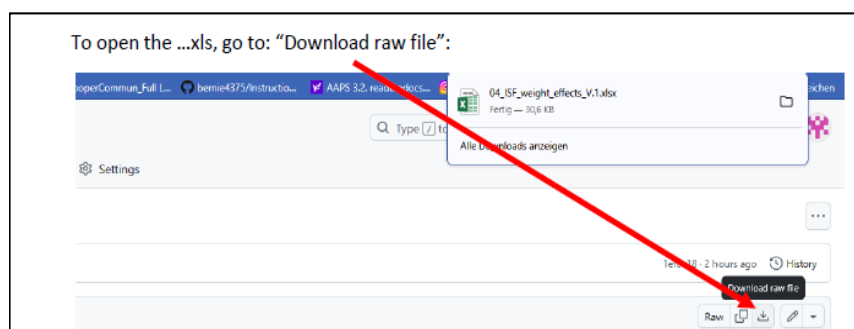
870

871 An **Excel tool** is provided
872 to download as raw file ...
873 ...from the e-book (Github
874 /bernie4375/section 04)
875 for these complex calculations.

876

877

878



879 The following table (from this tool) shows examples for combinations of **bg target** (yellow input field
 880 at box J1 resp. box J22) , **bg plateau level** (mg/dl, blue figures), and **duration** (minutes >10, in
 881 violet), the **iF** of **0.533** in our example above could originate (fields marked green):

	I	J	K	L	M	N	O	P	Q	R	S
1	target_bg	100 =>	iF factors resulting at different avg05 (mg/dl.bg), and duration (minutes)								
2	dura05;avg05	120	140	160	180	200	220	240	260	280	300
3	10	0,033	0,067	0,100	0,133	0,167	0,200	0,233	0,267	0,300	0,333
4	15	0,050	0,100	0,150	0,200	0,250	0,300	0,350	0,400	0,450	0,500
5	20	0,067	0,133	0,200	0,267	0,333	0,400	0,467	0,533	0,600	0,667
6	25	0,083	0,167	0,250	0,333	0,417	0,500	0,583	0,667	0,750	0,833
7	30	0,100	0,200	0,300	0,400	0,500	0,600	0,700	0,800	0,900	1,000
8	35	0,117	0,233	0,350	0,467	0,583	0,700	0,817	0,933	1,050	1,167
9	40	0,133	0,267	0,400	0,533	0,667	0,800	0,933	1,067	1,200	1,333
10	45	0,150	0,300	0,450	0,600	0,750	0,900	1,050	1,200	1,350	1,500
11	50	0,167	0,333	0,500	0,667	0,833	1,000	1,167	1,333	1,500	1,667
12	55	0,183	0,367	0,550	0,733	0,917	1,100	1,283	1,467	1,650	1,833
13	60	0,200	0,400	0,600	0,800	1,000	1,200	1,400	1,600	1,800	2,000
14	65	0,217	0,433	0,650	0,867	1,083	1,300	1,517	1,733	1,950	2,167
15	70	0,233	0,467	0,700	0,933	1,167	1,400	1,633	1,867	2,100	2,333
16	75	0,250	0,500	0,750	1,000	1,250	1,500	1,750	2,000	2,250	2,500
17	80	0,267	0,533	0,800	1,067	1,333	1,600	1,867	2,133	2,400	2,667
18	85	0,283	0,567	0,850	1,133	1,417	1,700	1,983	2,267	2,550	2,833
19	90	0,300	0,600	0,900	1,200	1,500	1,800	2,100	2,400	2,700	3,000

22	target_bg	74 =>	iF factors resulting at different avg05 (mg/dl.bg), and duration (minutes)								
23	dura05;avg05	120	140	160	180	200	220	240	260	280	300
24	10	0,104	0,149	0,194	0,239	0,284	0,329	0,374	0,419	0,464	0,509
25	15	0,155	0,223	0,291	0,358	0,426	0,493	0,561	0,628	0,696	0,764
26	20	0,207	0,297	0,387	0,477	0,568	0,658	0,748	0,838	0,928	1,018
27	25	0,259	0,372	0,484	0,597	0,709	0,822	0,935	1,047	1,160	1,273
28	30	0,311	0,446	0,581	0,716	0,851	0,986	1,122	1,257	1,392	1,527
29	35	0,363	0,520	0,678	0,836	0,993	1,151	1,309	1,466	1,624	1,782
30	40	0,414	0,595	0,775	0,955	1,135	1,315	1,495	1,676	1,856	2,036
31	45	0,466	0,669	0,872	1,074	1,277	1,480	1,682	1,885	2,088	2,291
32	50	0,518	0,743	0,968	1,194	1,419	1,644	1,869	2,095	2,320	2,545
33	55	0,570	0,818	1,065	1,313	1,561	1,809	2,056	2,304	2,552	2,800
34	60	0,622	0,892	1,162	1,432	1,703	1,973	2,243	2,514	2,784	3,054
35	65	0,673	0,966	1,259	1,552	1,845	2,137	2,430	2,723	3,016	3,309
36	70	0,725	1,041	1,356	1,671	1,986	2,302	2,617	2,932	3,248	3,563
37	75	0,777	1,115	1,453	1,791	2,128	2,466	2,804	3,142	3,480	3,818
38	80	0,829	1,189	1,550	1,910	2,270	2,631	2,991	3,351	3,712	4,072
39	85	0,881	1,264	1,646	2,029	2,412	2,795	3,178	3,561	3,944	4,327
39	90	0,932	1,338	1,743	2,149	2,554	2,959	3,365	3,770	4,176	4,581

883
 884
 885 Still. a “trial and error” approach might be easier to handle (see the following section, 4.5.6):

886 *Off topic:* dura_ISF is also very useful in Hybrid Closed Loop. It can be used to elegantly manage,
 887 fully automatically, a temporary insulin resistance from fatty acids. Please refer to other papers for
 888 details (for instance, sections on FPU and persistent high bg in “Meal Mgt.3....pdf”, available here:
 889 <https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings>).

891 4.5.6 Set your dura_ISF

893 Set a **start value of 0.2** for your dura_ISF_weight, and increase only cautiously with an eye on
 894 hypo prevention 2-3 hours later.

895 Caution: Fine tuning this parameter only makes sense **after** you tuned your bgAccel_ISF and
 896 pp_ISF well (so your thin yellow insulin activity curve shifts *as far to the left*, towards meal start,
 897 *as possible*, which will lower bg peaks and ease the job for dura_ISF).

898 4.5.7 Set your bg_ISF

899

900 Since in Full Closed Loop we make our loop give us the maximum SMB size it can, at the
901 beginning of a rise, it is crucial to **resist the temptation to continue** with a particularly **strong ISF**
902 in the meal phase with the **highest glucose** values .

903 This is a reason why in Full Closed Loop we do not make much use of the **bg_ISF** component of
904 autoISF.

- 905 • Wanting to get most of our insulin from SMBs delivered at fairly low (but beginning-to-rise)
906 bg implies that we do **not** make ISF weaker at low bg. Under preferences/OpenAPS
907 SMB/autoISF/bg_ISF settings you could set **lower ISF_range_weight** = 0.0.

908 If you want to analyze in your data, whether you might benefit from a milder ISF at low bg
909 values (e.g. if you often go below target after correction of only mildly elevated bg in the
910 preceding hours), you may want to try lower ISF_range_weight = 0.1 or 0.2. Study the
911 effects from bgISF, and increase, or decrease, the bgISF_weight to fine tune the sought-
912 after affect.

- 913 • The **higher_ISF_range_weight** is used when bg is above target, It then strengthens ISF
914 the more the higher the set weight is. 0 disables this contribution, i.e. ISF is constant in the
915 whole range above target.

916 In FCL, this factor should be fairly irrelevant: Near glucose peak, zero-tempering usually
917 prevails anyway, so the settings we try might often not be used really by the loop. Very
918 likely, you can live with setting the weight to = 0.0 here, too.

919 If you want to analyze in your data, whether you might benefit from a stronger ISF at high
920 bg values (e.g. if you often remain above target after correction of elevated bg in the
921 preceding hours), you may want to try higher ISF_range_weight = 0.1 or 0.2. Study the
922 effects from bg_ISF, and increase, or decrease, the higher_ISF_range_weight to fine tune
923 the sought-after affect.

924 In case bg_ISF shall play a bigger role in your loop, please consult the related developers'
925 documentation (Quick Guide, page 4) at: [https://github.com/ga-](https://github.com/ga-zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf)
926 [zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf](https://github.com/ga-zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf) .

927

928 4.5.8 “Quality control” on your tuning for the later half of your meal time

929

930 The later stages of meal management (both, in HCL and in FCL) struggle with the problem that
931 there is a **hypo danger** from the “tail” of insulin activity from earlier SMBs that were needed to
932 fight high bg or plateaus associated with temporary insulin resistance.

933

934 Once your bg sits high, neither you, nor a hybrid closed loop with all the carb info, nor your FCL
935 can work wonders.

936

937 Very important:

938 • Iterate between **2 or 3 kinds of meals** (from your typical spectrum) to find **one** set of
939 settings that works *good-enough for all*. That should be possible.

940 • If you can't make it work for certain meal types, see [sections 4.7](#) and [5](#). what you can do
941 then.

942 Observe hypo trends after meals, and

943 • resist the temptation to elevate the **dura_ISF_weight** very high.

944 • try to stay away from **bg_ISF** or dynamicISF in Full Closed Loop:

945 ○ In FCL you probably can afford to shut bg_ISF entirely off via setting both related
946 _weights to 0.0.

947 ○ At least be careful, use small ISF_range_weights and check whether you are happy
948 with the contributions to the effectively used ISFs

949 ○ *Off topic*: If, coming from dynamicISF usage, you stay in **Hybrid** Closed Loop, but now with
950 autoISF, you probably can use the bg_ISF parameter with higher _weights to emulate what
951 you like to replicate from your dynamicISF experience.

952

953 bg highs will take time to resolve.

954 Interestingly, an after-dinner walk can work wonders sometimes (take glucose tablets along).

955

956 Zero-tempering and too tightly set safety limits can be **stumbling blocks in your tuning** project:

957 • Investigating effects of set ISF_weights is not really possible in periods of zero-tempering.

958 • Too tightly set safety limits “allow” tuning that really is way too aggressive, but gets “cut” by
959 your too-cautious safety settings (e.g. for SMB_range_extention, or for autoISFmax).

960 Aggressive settings then could not come into play most of the time.

961 However, some *other* time they might come into play, and *then* produce a hypo 1-2 hours
962 later.

963

964 Therefore, **carefully study the SMB tab** (or better yet, do an **emulator** based analysis, see
965 [sections 10-11](#)) to see

966 • what the selected weights **would** do, if there was **no zero-tempering** at the time, and

- 967 • whether you bump into a **set limit** already (if your bgAccel_ISF_weight makes you exceed
968 allowed max. SMB size, then further tuning your settings only makes sense with either
969 allowing bigger SMBs, or limiting bgAccel_ISF_weight to a lower number at which you will
970 not frequently bounce into the SMB limit)
 - 971 • at which **other** times (rather than the one you currently look at and try to improve) that
972 selected setting might backfire
- 973
- 974

975 4.5.9 How your “UAM” loop concludes insulin need for your un-declared carbs

976

977 The UAM Full Closed Loop doesn't get any information from you as to how many grams of carbs
978 will be there, for absorption.

979

980 Looking back

981

982 For the recent 5-minute segments, the UAM oref(1) loops can precisely calculate how many grams
983 of carb “must have been digested” based on the CGM values seen, and your IC and ISF profile
984 parameters

985 For more detail see chapter 1.2 on how dynamic carb absorption is calculated, in “Carb ratio (IC,
986 CIR)...pdf” at: <https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings>.

987

988 Looking into the next minutes, hour

989

990 However, *here* we worry about the *late meal stage*, and our FCL has gotten no information from us
991 about how many grams **in total** were eaten, and certainly we do not bother to give eCarbs with
992 estimated **absorption times** (that are so essential in iOS Loop).

993

994 So, in FCL you leave your loop without knowledge when your steady-state max carb absorption
995 phase...

996 ○ the earlier mentioned 30g/h, or

997 ○ with gastroparesis, or if on GLP-1 drug treatment, probably on a lower g/h level

998 ○ sometimes prolonged (“faked”) by a brief episode of insulin resistance to fats

999 ...might end. Nor, whether extra carbs were added, later, or “FPU’s are lurking”.

1000

1001 The FCL now needs to provide desired amounts of insulin, while facing a potentially induced hypo
1002 danger later (considering the DIA of all the insulin still active).

1003

1004 Fortunately, the UAM Full Closed Loop is *not completely clueless* regarding how carb absorption
1005 *will continue*:

1006

1007 It will work with a **prediction** of *further* carb absorption, building on the **carb deviations**
1008 (=calculation of how much got absorbed in the *past* 5 minute segments), and phase out further
1009 *expected* carb decay in the course of the next 1 to max 3 hours.

1010

1011

1012 For more detail see

- 1013 • <https://openaps.readthedocs.io/en/latest/docs/While%20You%20Wait%20For%20Gear/Understand-determine-basal.html#understanding-the-basic-logic-written-version>
- 1014
- 1015 • *or do a real-time study* with (screenshots from) your SMB tab info.

1016

1017 Discussion

1018

1019 **This UAM prediction** about further carb absorption can be worse, but **can also be better than a**
1020 **prediction based on the user's „e-Carb“ input** as done in Hybrid Closed Loop.

1021

1022 In any case, and even when having perfect knowledge about how exactly the carbs fade out in the
1023 next hours, there would still be a principal problem for the loop: Heavy insulin „fire“ against highs
1024 will not work immediately (depending on the insulin's time-to-peak), and notably it comes with a
1025 significant hypo danger from the „tail“ of insulin activity.

1026 A big bolus, or also a series of boli, will rarely work exactly for several hours matching the
1027 absorption of carbs (from what, how much and and how fast the user ate).

1028

1029 *Off topic closing remark:* With meticulous attention to all carb-related profile parameters, and daily
1030 inputs on amounts and absorption times, plus some “mindfulness” as to which diet habits disturb the
1031 possible balance, there are “pro” loopers (notably on iOS Loop) who achieve impressive %TIR
1032 (and % in tight range) performance. – The author consciously chose the other way, to put substantial
1033 effort into a personalized upfront system calibration, and work with a `oref(1)` algo system that allows
1034 (nearly) every day hands-off FCL.

1035

1036 4.6 Tuning your initial settings

1037

1038 Be pro-active: **The earlier large SMBs come** (driven by `bgAccel_ISF` and `pp_ISF`) ...

1039 Note: Also your CGM smoothing may play a role here, that you may want to look into !

1040 ...the **less high** the overall increase in BG will be, and (provided you set a proper `iobTH`)
1041 the **lesser** the **risk** will be **for a hypo** after the meal.

1042

1043 Therefore, **put most of your FCL tuning effort into determining suitable weights for**
1044 **`bgAccel_` and for `pp_ISF`, and for finding a suitable `iobTH_percent`.**

1045

1046 Low carbers probably should pay more attention on **`dura_ISF`**, besides seeing to it that
1047 `bgAccel_ISF` is not too aggressive (see above, [section 4.2.5](#) and [case study 4.2](#)).

1048

1049 Later, your “FCL cockpit” will give you access to **temporarily modulate** these essential
1050 parameters (see [section 5.2.](#)), providing you an opportunity

- 1051 • in your tuning phase, for more research on the fly, so to speak
- 1052 • everyday, for temp. adaptations to altered insulin sensitivity, or to special
- 1053 disturbances (should you, occasionally, see a need).

1054

1055 After you tuned your **initial settings** well, there should rarely arise a need for “fine tuning” later,
1056 see [section 8](#) and [case study 8.2!](#)

1057

1058 The experience of the author is that it is possible to tune the above mentioned weights for very
1059 different meals in such a way that the glucose almost always remains acceptably in range.

1060

1061 However, if you come to the conclusion that **differentiated settings** (for different meals or meal
1062 time clusters) would be easier to establish, and/or work better for you, the following sections
1063 suggest many options you could try and use.

1064

1065 4.7 Maneuvering through more complex scenarios

1066

1067 You now can move on, to accommodate more complex scenarios.

1068

1069 4.7.1 Complex meal spectrum

1070

- 1071 • Especially if you are a bit shy of using the Emulator ([section 10](#) and [11](#)) for really detailed
1072 analysis, it can well be that you will not hit *one* real good system calibration ([section 4](#)) for your
1073 *entire range* of diets (e.g. your *meal spectrum* at all your lunches).
 - 1074 ○ Note that *between meal time slots* (e.g. breakfasts vs lunches) you should differentiate
1075 via different “circadian” *profile_ISFs* (with which the autoISF-effects always multiply).
- 1076 • So, in case you occasionally run out of range (bg =70...180 mg/dl), your options to prevent,
1077 react, or improve are:
 - 1078 ○ accepting a few % higher time outside of range for that day (and, if feasible, in the
1079 future avoiding what seemed to have caused it)
 - 1080 ○ taking a snack (whenever you tend to go low from the “tails” of insulin activity that was
1081 required to fight a peak)

- 1082 ○ doing a manual “tweak” (if you can think of one in time), to manage the problem
- 1083 manually. For example, briefly going into an odd TT (=temp. blocking more SMBs) can
- 1084 be a very easy-to-handle remedy, sometimes
- 1085 ○ define a User Action Automation, and provide an extra “cockpit button” to announce a
- 1086 meal *outside of your usual spectrum*, so it will automatically be treated differently by
- 1087 your FCL (as you defined in your Automation; example: [Case study 5.2](#)).
- 1088 ○ temporarily resorting to “your old” hybrid closed loop.

1089

1090 Instead of accepting such instances, you could launch “improvement projects”, that refine your

1091 initial tuning ([section 4](#), and [sections 8](#) and [9](#))

1092

1093 Note, though, that it could be near-impossible to fine-tune *if your basics never were “right”* and you

1094 got lost in a maze of errors and counter-errors.

1095 In that case, **only a fresh start might convincingly help.**

1096

1097 4.7.2 Complex tasks aside from managing meals

1098

1099 To deal with *different* disturbances than presented by your meal spectrum (that you were

1100 calibrating for in this section 4), there will be **other** instances where **temporary modulations** of

1101 your FCL will be needed.

1102

1103 You have a variety of options to deal with that, and this will be the topic in [section 5](#).

1104

1105 It is suggested to do **major exercise** still *in your hybrid closed loop* setting, *until* you have your

1106 FCL up and running for meals on normal days with no or only moderate exercise.

1107 Later, implement extras as discussed in [section 6](#) to fully implement your FCL.

1108

1109

1110

1111

4.8 Profile helper

DRAFT by John Kitching/edited

For general loop settings for FCL with autoISF, please consult [sections 2.1 – 2.6](#)

The following table gives a comprehensive approach how to tune your autoISF FCL better, when you see any of the problems as in *column A*.

Make sure to work through the problems in the order given in this table.

	A	B	C	D
1	Notes: 1. if not entering carbs then "several hours after eating" can be applied instead of "with zero COB"			
2	The problem (follow <u>in order</u>)	Y/N	Possible solution	Based on what logic
3	Are you having periods with zero COB and negative IOB?	Yes	Decrease basal a bit over these periods, wait a couple of days to evaluate and return here	Oref is backing off your basal to try and hold your BG steady so basal is probably too high
4		No	Continue with this sheet	
5	Are you having periods with zero COB and positive IOB?	Yes	Increase basal a bit over these periods, wait a couple of days to evaluate and return here	Oref is increasing your basal to try and hold your BG steady so basal is probably too low
6		No	Continue with this sheet	
7	Do you get roller coaster BGs?	Yes	Increase profile ISF a bit (make weaker). Also, check your set iobTH%. Reevaluate over a couple of days, return here	BG goes over target -> with too-strong ISF, too much insulin is dosed resulting in BG below target. Long zero-temping required, but resulting in high BG next ...
8		No	Continue with this sheet	
9	After your BG went high, do you get a hypo later (from remaining insulin "tail" at zero COB)?	Yes	Reduce autoISF "weights" a bit, reevaluate over a couple of days, return here	ISF is reduced (strengthened) too much by autoISF as you move away from target. Reducing the proper ISF_weight will reduce that impact. Use the autoISF history table for more information about which one is causing the issue: Preferably, "shave of late", at DURA or BG; PP or ACCEL weights might need reducing, too.
10		No	Continue with this sheet	
13	When you start eating with BG around target and iob near zero, do you get a hypo (in the first 2 hours)?	Yes	Check whether you can reduce your set iobTH%, or SMB range extension, or autoISFmax. Decrease PP (and maybe also ACCEL) "weight", and increase profile carb ratio a bit (make it weaker, so you see the insulin needed relate well to the g of carbs digested by the time you see a hypo tendency). Reevaluate over a couple of days, return here	You're getting too much insulin to cope with the bg rises from the carbs you've eaten. Taming the loop can be done in several ways: Weakening profile carb ratio and ISF would work in all situations. Lowering ACCEL and/or PP autoISF "weights" would exactly weaken loop over-response in early stage of BG rise. And the 3 first-mentioned safety settings just limit excesses.
14		No	Continue with this sheet	
17	When you eat, is iob building up too slow, with a lot of it added at bg peak or even still when BG reduces?	Yes	Check whether you must increase your set iobTH%, or SMB range extension, or autoISFmax. Increase PP "weight", and decrease profile carb ratio a bit (make it stronger, so you see the insulin needed relate well to the g of carbs digested). Reevaluate over a couple of days, return here	You're not getting enough insulin to cope with the bg rises from the carbs you've eaten. If your loop bounces into any of the 3 first-mentioned limits, "tuning more aggressive" might simply not work. Making the loop more aggressive can be done in several ways: Strengthening (lowering) profile carb ratio and ISF would work in all situations. Elevating autoISF "weights" (notably PP) could exactly strengthen loop response in instances where needed (where the respective "weight" is playing a role).
18		No	Continue with this sheet	
19	Does BG stay high for long periods?	Yes	Increase DURA "weight" a bit. Reevaluate over a couple of days, return here	DURA reduces ISF (makes it stronger) if BG stays high for longer periods than it should. Reminder: Follow this sheet <u>in order</u> ! This "last job", dealing with persistent highs via DURA, is much easier after you sorted out how to build-up iob faster, so not to go super high in the first place.
20		No	Have a short holiday with lots of carbs	
22	Further reading:			
23	Ga-zelle's quick start guide		https://github.com/ga-zelle/autoISF/blob/A3.2.0.4_ai3.0.1/autoISF3.0.1_Quick_Guide.pdf	
	FCL e-Book, Trouble Shooting		https://github.com/bernie4375/FCL-potential-autoISF/blob/FCL-e-book/09_Trouble.Shooting_FCL-	