Please note that with autoISF 3.0 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 <u>section 0</u>

4.1 Getting started

4.2 bgAccel_ISF_weight

4.3 pp_ISF_weight

4.4 bgBrake_ISF_weight and bg_ISF

4.5 dura_ISF_weight

4.6 Tuning your initial settings

4.7 Profile helper

Available related case studies:

Case study 4.1: Pizza
Case study 4.3: Hands-off FCL on Xmas

Warning regarding importance of proper profile ISFs.

Starters on autoISF FCL who are coming from using HCL with **dynamic**ISF must be aware of the following: It is absolutely essential to build your FCL on properly set **profile** ISFs (likely a circadian pattern over 24 hrs). It may not apply to you, but many dynamicISF users did never bother to determine their ISFs that would maximize their HCL performance, but employ dynamicISF so to speak for going „dynamically" through a wide range of possible ISFs, until eventually hitting a sweet spot, and the whole thing works better than before with their profile ISF (often only one, e.g. coming from Autotune).

The following is important to understand, as it also leads straight into the core idea behind FCL with autoISF, too: It is a good idea to establish a well-running hybrid closed loop with set (non-dynamic) **ISF (as in profile each hour of the day).** That ISF must be **aggressive enough** that it gets you down from a high around 200 mg/dl to target. That is roughly also the way you experimentally determined it (I hope).

Using that value also at lower bg, on the way up (after meal start), is very positive, as it is probably **stronger** than you would use, if you had just that (lower) bg to correct. autoISF will also do just that, but in a much more pronounced and elegant way.

On the way down from peak to glucose target, a somewhat too strong ISF will not hurt because much of the time your loop (well supplied with insulin before, „on the way up") is zero temping or at least has only a small gap to correct from predicted bg to target bg.

37 You have no business to be much above 200 mg/dl where an even stronger ISF may or may not
38 help. It sure does not help at an occlusion which is about the only reason to see super high values
39 as an experienced looper.
40 Pegging ISF strength to bg level therefore does not make much sense for us. You will use the
41 autoISF toolbox to get strongest ISF **at low** but beginning-to-rise bg,
42   <u>Disclaimer:</u> There are very much refined versions of dynamicISF that can have beneficial
43   applications. But going to autoISF FCL, you absolutely must anchor on the proper
44   profile_ISF (which in times of illness etc. you can temp. change via profile switch, also when
45   using autoISF in FCL).
46
47 Warning not to simply copy settings from others
48
49 When setting **your** parameters, **don't use any given numerical example**, but data from **your**
50 *successful* Hybrid Closed Loop!
51
52   Most *examples given in this paper* are from an adult diabetic (Lyumjev, G6) whose insulin
53   sensitivity can be characterized as follows: approximately 37 U TDD, thereof 13 U profile
54   basal, at about 200g daily carbs from mainly lunch and dinner; no couch snacks or sweet
55   drinks. The user also participates in multiple instances of daily moderate activity such as
56   dog walking, biking and gardening. In Hybrid Closed Loop, a typical meal bolus was 8 U
57   that was sometimes reduced such as when activity followed the meal.
58
59   After seeing some more inputs from a variety of users we might put together a profile helper
60   for some rough orientation and plausibility cross-checking in <u>section 4.7</u>
61
62 Warning. Importance of starting from a well-performing Hybrid Closed Loop
63
64 A **satisfying performance in Hybrid Closed Loop** mode is a pre-requisite. Expect to reproduce
65 about the same %TIR also in your FCL, but with less daily interaction, once established.
66 Note that this refers to prior use of „vanilla" software, without fancy „dynamic add-ons" (such as:
67 Autotune determined factors, dynamicISF etc). that probably will not be compatible with autoISF
68 use, and may have introduced bias into the profile settings you bring with you into FCL now.
69
70 To reach a satisfying performance you must start from a hybrid closed loop in which you did
71 **master your meal management well** using the oref(1) algo SMB+UAM**.**
72 This is a pre-requisite **to be able to forget it** … - because the initial tuning we now turn to
73 demands that you analyze your prior best practice, in an attempt to find appropriate settings and
74 „teach" your FCL to come up with the necessary iob.

This is the main subject of this section 4 (finding settings for automatic meal management) and sections 5 and 6 (finding settings for highly automatic management also of other potential disturbances).

4.1 Getting started

Make sure you have studied the preceding sections 1-3 on the general pre-requisites for FCL and on the workings of autoISF. Notably make sure you have set your default iobTH (refer to section 2.4 and if available 4.7)

In the early test phase, it is recommended to:

- run the system as dummy, not connected to your body (or, on own risk, connect only as long as you watch closely)

- in AAPS preferences, switch your autoISF FCL (= **autoISF/"Enable adaptation of ISF to glucose behaviour"**) ON only during daytime hours of a meal, *e.g. 11-18h*, for fully automatic "full closed loop" management *of lunches*.
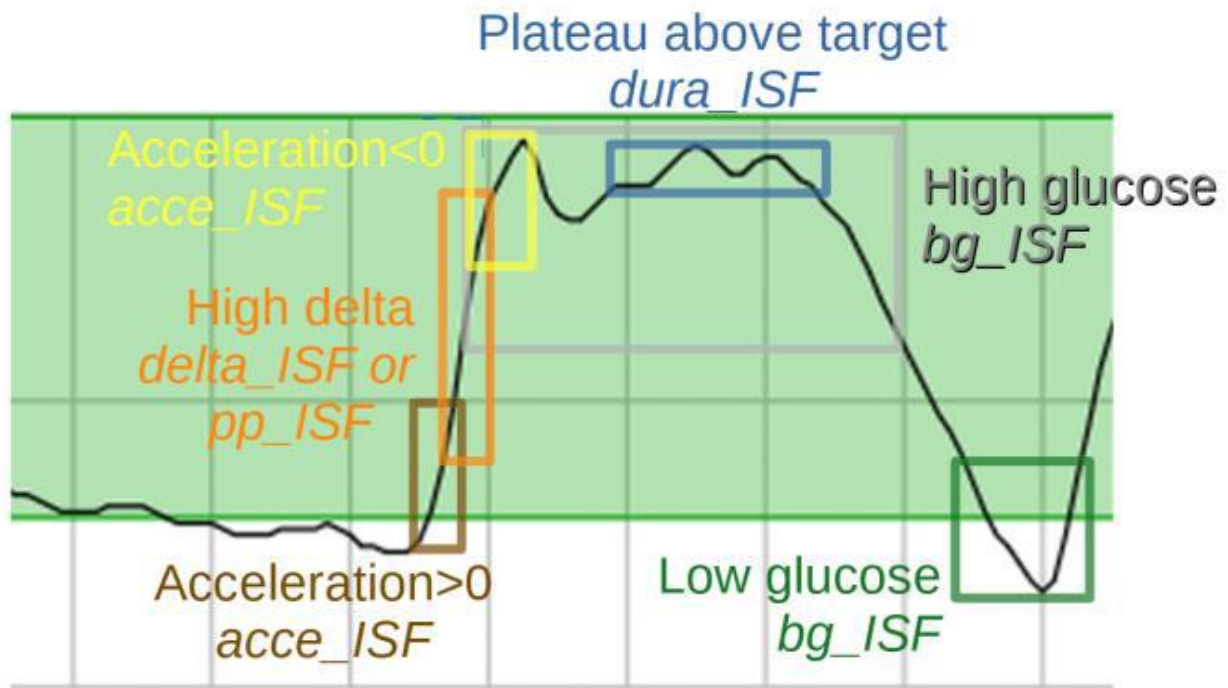
    You can do this switching manually *at 11 h and 18 h every day*, *or* set up an Automation that does that (see section 3.4).

- take typical but not extreme *lunches*. Omit sweet drinks, or drink only slowly

- do not use the Activity monitor (see section 6.6), unless it is already well calibrated. In case you use an EatingSoonTT at meal start: Any active TT shuts activity monitor automatically off.

It is then essentially a matter of your UAM Full Closed Loop recognizing a meal start from the glucose trend, and ramping up iob.

When setting up your autoISF Full Closed Loop, you must set several ISF_weight parameters in AAPS Preferences/OpenAPS SMB/autoISF settings. They relate to different stages of the typical glucose curve after starting a meal:

Plateau above target
dura_ISF

Acceleration<0
acce_ISF

High glucose
bg_ISF

High delta
delta_ISF or
pp_ISF

Acceleration>0
acce_ISF

Low glucose
bg_ISF

103

104   The core advantage of using autoISF with oref(1) SMB+UAM (in FCL as well as in hybrid closed

105   loop) is that it manages the glucose curve it sees developing, no matter what the underlying reason

106   is. 42 potential factors were identified (see: https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-

107   IC-settings/blob/FCL-w/autoISF/42%20factors%20influence%20bg.pdf), so, no wonder, that

108   loopers who meticulously input their carbs will often not see the expected result.

109   Reminder: autoISF has that advantage only if the pre-requisites (section 1) are given,

110   notably a very fast insulin.

111

112   Before you process, make sure you studied the flowcharts in section 3 that describe how autoISF

113   calculates the effective(ly used) ISF.

114

115   Warning: **Any bolus you „sneak in" will severely distort the glucose curve. That can render**

116   **your tuning of weights** (see below) **useless, and could make your loop act in unpredictable**

117   and potentially (see last bullet point below) dangerous **ways:**

118   • Your FCL ideally runs <u>without</u> an insulin button at the bottom of the AAPS home screen.

119   • Issuing a bolus should kick you out of the FCL mode, back into Hybrid Closed Loop. We are

120   working on improving the User Interface (see e.g. section 5.3.1) that would facilitate and

121   secure the bi-directional transitions.

122   • How proper autoISF settings would differ for your meal management, depending on no-

123   bolus, bolus like in HCL, or very small pre-bolus (Meal Announcement), is not well

124   investigated at this point.

125   Therefore it is best to remain consistent = use autoISF strictly for no-bolus FCL, and if you
126   want to bolus for a meal, switch ISF adaptation to glucose behavior (autoISF) temporarily
127   OFF.

128   •   Maybe we are too cautious here, and in fact the autoISF adaptation to glucose behavior is
129   tolerant enough of disturbances by **user boli**. Please report your findings in case you
130   collect data of "mixed use" (FCL / Meal Announcement / HCL use with meal bolus). (A n=1
131   finding, and guide how to evaluate, is reported here: [https://github.com/ga-](https://github.com/ga-zelle/autoISF/blob/A3.2.0.2_ai3.0/To%20prebolus%20or%20not%20to%20prebolus.pdf)
132   [zelle/autoISF/blob/A3.2.0.2_ai3.0/To%20prebolus%20or%20not%20to%20prebolus.pdf](https://github.com/ga-zelle/autoISF/blob/A3.2.0.2_ai3.0/To%20prebolus%20or%20not%20to%20prebolus.pdf)).

133   *Once we have a body of data, including from those who moved from HCL with*
134   *autoISF to FCL, we may need to re-define what the bi-directional transitions FCL <*
135   *- > HCL in detail shall mean, and whether or not this has implications for needing*
136   *different autoISF settings in /preferences for FCL and for HCL. .*

137

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

141

142   Depending how satisfied you will be with the result, or which more extreme meals (smaller?
143   faster/slower carbs? totally different fat/protein content?) you would like to manage, as well,
144   you have a variety of options to deal with that, and this will be the topic in sections 5 and,
145   focused on exercise, in section 6.

146

147   In a nutshell, this will be about manual *or* (aided by Automations you would set up) semi-
148   automatic (user triggered) *or* fully automatic **temporary modulation** of your FCL **to deal**
149   **with *different* disturbances than presented by the meal spectrum you were**
150   **calibrating for.** This "nudging" will often involve:
151   * the **%profile button** (top left on your AAPS home screen). Note that the set % multiplies
152   with both, the ISF resulting from autoISF and also with the default iobTH you have set, so
153   both are nicely modulated in a linear way with the % temporarily chosen
154   * the **TT button** (top right on your AAPS home screen). Note that a lowered (relative to
155   profile glucose target) TT signals lowered sensitivity (more insulin need), and an elevated
156   TT (as often used with exercise) increases sensitivity and hence works in the direction of a
157   lowered % profile to also reduce insulin given by the loop.
158   Moreover, the **exercise button** ((top center on your AAPS home screen) can be activated
159   (turns yellow, then). This will **further boost** how your set TT elevates the resulting ISF, and
160   sharply lowers iobTH, as often desired for sports. See section 6.1).

161

162   Taken together with a couple of more features (section 5.2 and 6.3), these functions make
163   the AAPS home screen your **FCL cockpit**.

164

165 So, yes, FCL is about fully automatic cruising. However, you have a cockpit to check how
166 everything is running, to sometimes "nudge" – and in exceptional situations also to temporarily
167 intervene, or even take over.

168

169 Also, like a pilot, you need to learn a bit, so everything will fly well.

170

171 But: You should do some fair weather stuff first *), which brings us back to our intended next step:

172

173 Researching your standard meal

174 patterns, and finding settings

175 for the various .._ISF_weights.

*) If, to keep the motivation up for your project, you are itching to see what fancy stuff can all be done, you might peek for instance into case study 6.2 And if that looks like way too much, decide to be just a fair weather flyer for now - or, no offense taken, give up now before spending too much effort. Section 13 is about (maybe) "easier" alternatives.

176

177   ## 4.2 bgAccel_ISF_weight

178

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

182

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

186

187 Rule of thumb: Two of the first three SMBs each should be about ¼ (max 1/3) the size of a
188 previous meal bolus in your HCL „career".
189   Going over 1/3 can be problematic if your diet contains occasional low carb (or only
190   snacking), and generally of course if your CGM quality is sometimes unreliable, and might
191   produce an artefact that could be mistaken for a meal start. Be vigilant about this topic!

192

193 For hands-off FCL, your settings have to fit the whole **range of your meals**. In extreme cases you
194 will have to balance too high running iob with additional carbs (a late additional snack against
195 going too low), and in the opposite case, you will have to reckon with temporarily exceeding the
196 glucose target range and losses of the achieved %TIR for this day.

197

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

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

  In case you use autoISF 3.0 on the iAPS platform for i-phones, you need to use a third party automation software (! call for a case study 4.X)

- You can pre-program **custom buttons for special** meal (or snack) **types**, with different underlying FCL settings (see "cockpit", section 5.2.2.3)

- You can **modulate FCL aggressiveness manually** making use of temporary switches of %profile and/or set glucose target (section 5.2.2.2)

- In an update, autoISF 3.x might provide the option to pre-program settings for 4 different meal type clusters, accessible from the TT button (presented in section 5.3.3.1 (4) and 6.3).

In search of appropriate settings, you must keep (real-time) track of the **SMB tab** when tuning. This can be impractical. You probably will end up making a lot of screenshots (quickly in the crucial minutes where the SMBs were given, or when you thought they should be given), for later analysis.

The superior method is to just copy **logfiles** about once a day from your phone/internal memory/AAPS/logs (all zip files there), and analyze them at your convenience later, using the **emulator** (see section 10; used e.g. in last pages of case study 4.1). Some emulator-based analysis is also possible within AAPS on your phone (section-11).

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

- Especially if your *profile basal* rate is very small, the **smb_max_range_extention** and/or the **autoISF_max** "must" often be increased further.

- Furthermore, the **smb_delivery_ratio** provides more leeway to increase the aggressiveness (e.g. 0.6 -> 0.72 results in another +20%).

In the end you should *not set the limits too tight*, so "nudging" aggressiveness by another 10 or 20% from your cockpit later will not bounce into restrictions.
On the other hand, setting the *limits too high* might make your loop bounce, regardless of the carb load, "immediately" into your iobTH limit (and up to 30% above), which is not desireable if your meal spectrum is varied.

235   In any case, it is worth the effort to tune the **bgAccel_ISF_weight** in such a way that high glucose

236   increases are already nipped in the bud, so to speak.

237

238   This also facilitates the tuning task for the subsequent phases of the meal, because there is then

239   largely zero-temping, as well known from HCL-times after YOUR administered bolus. Also, the

240   lower and shorter lasting the glucose peak, the lesser the hypo danger from the activity tail of

241   SMBs given when glucose was „stuck" high.

242

243   Default bgAccel_ISF_weight is set to zero in autoISF. **To start**, I would try 0.05 or **max 0.1**, and

244   keep trying in max 0.05 steps. Soon move to 0.02 steps. From my (very limited) overview, many

245   use around 0.2, but possibly higher if their hourly basal rate is 0.1U or lower. (Consult section 4.7

246   when available). Do not be tempted to rush this setting by using large jumps in adjustments.

247   How changing the _weights influences the resulting calculated insulinRequired

<- wrong info in past versions ! Examples added for clarification of this important tuning related topic:

248   ~~If you double the bgAccel_ISF_weight, the ISF strengthening is doubled.~~

249   To get a feel for how changing the _weights influences the resulting calculated insulinRequired, it is

250   best to start cautiously and just do 10 to max 20% steps up, and watch out for the effects. Doing

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

252   *Example 1: Going from bgAccel_ISF_weight of 0.2 to 0.16 (20% less).*

253   *If your profile_ISF is 40 mg/dl/U and with bgAccel_ISF_weight = 0.20 you saw acce_ISF*

254   *factor of 1.31, this would ((if the acce influence dominates and is used as effective ISF))*

255   *lead to the effectively used ISF of 40/1.31 = 30.53 mg/dl/U. For an intended correction by –*

256   *10 mg/dl the insulinRequired would calculate to 10 / 30.53 = 0.328 U.*

257   *Now, going with a 20% reduced bgAccel_ISF_weight of 0.16:*

258   *acce_ISF = 1+ bgAccel_ISF_weight * internalFactor*

259   *before   1,31 = 1 + 0.20 * iF => 0.31 = 0.20 * iF => iF = 1,55*

260   *after   ? = 1 + 0.16 * iF => ? = 1 + 0.16 * 1.55 = 1.25*

261   *New effective ISF would be 40 / 1.25 = 32.05 mg/dl/U. For an intended correction by – 10*

262   *mg/dl the insulinRequired would calculate to 10 / 32.05 = 0.312 U, which is 4.9% less.*

263

264   *Example 2: Going from bgAccel_ISF_weight of 0.2 to 0.10 (50% less; or doubling in the*

265   *other direction).*

266   *If your profile_ISF is 40 mg/dl/U and with bgAccel_ISF_weight = 0.20 you saw acce_ISF*

267   *factor of 1.31, this would ((if the acce influence dominates and is used as effective ISF))*

268   *lead to the effectively used ISF of 40/1.31 = 30.53 mg/dl/U. For an intended correction by –*

269   *10 mg/dl the insulinRequired would calculate to 10 / 30.53 = 0.328 U.*

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

271   *acce_ISF = 1+ bgAccel_ISF_weight * internalFactor*

272   *before   1,31 = 1 + 0.20 * iF => 0.31 = 0.20 * iF => iF = 1,55*

273   *after   ? = 1 + 0.10 * iF => ? = 1 + 0.10 * 1.55 = 1.155*

274   *New effective ISF would be 40 / 1.155 = 34.63 mg/dl/U. For an intended correction by – 10*

275   *mg/dl the insulinRequired would calculate to 10 / 34.63 = 0.289 U, which is 12 % less*

276   *(going the other way, 0.328 is 13.5 % more).*

277

278   *Example 2 (-50%) reduces _weight 2.5 times lower than example 1 (-20%), and the*

279   *resulting effect (-12% vs. -4.9% insulin Required) is also factor 2.5 different. ((Still,*

280   *the crossed out sentence on the preceding page was misleading as to what*

281   *"strengthening" shall mean))*

282

283   Note: "Your" internal factor "iF" might differ; for sure it is very different between the

284   various …_ISF components. (Also, never forget to look into how other .._ISFs play into the

285   effective_ISF that overall results).

286

287 Ideally, one should set the bgAccel_ISF_weight so that for meals that are in the **lower** range of the

288 "fast **carb load**" of your cluster, the necessary insulin supply is already approximately provided

289 with 3 SMBs.

290

291 The glucose curve, at such meals, begins to flatten early in this SMB phase, so a **deceleration**

292 follows very soon (-> section 4.4).

293

294 Note regarding acceleration happening "again" in late part of dropping glucose

295

296 In the late stage of falling bg, the glucose curve is like an accelerating parabola again. The

297 algorithm tries to evaluate when and at which bg level complete digestion of the meal and

298 a bg minimum will result. Insulin required to stabilize around target bg is usually very small,

299 and the adaptation of ISF in that stage relatively unimportant.

> 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.

300
301

4.3 pp_ISF_weight

303
304 With **higher carb load** meals, or meals that come with a sweet drink, the acceleration phase will

305 last longer, and bg will rise further, which will require a higher insulin supply.

306

307 Between acceleration and deceleration there is a more or less linear further increase of insulin
308 need in these cases.

309

310 autoISF should now "fight" this with the help of the post-prandial ISF, set via **pp_ISF_weight,** after
311 we have set a halfway suitable bgAccel_ISF_weight.

312

313 Select **pp_ISF_postprandial all day = ON**

314

315   In full closed loop mode, this parameter is preferred over deltaISF.

316

317   pp_ISF and bgBrake_ISF (see next section) are probably the most valueable parameters to
318   tune for managing meals with gastroparesis, or if you take one of these novel drugs that
319   lower digestion speed (Please supply case study!).

320

321 Tune your **pp_ISF_weight** *after* you have set a halfway suitable (not too aggressive)
322 bgAccel_ISF_weight. You now should check meals in the upper spectrum of your g carb, and
323 carefully start tuning with a weight of 0.01.

324

325 Normally (except for very low carb meals) the SMBs triggered by bgAccel_ISF_weight <u>and</u>
326 pp_ISF_weight should be sufficient to reach and slightly exceed the **iobTH** (see <u>section 2.4</u>) so all
327 *the other* autoISF parameters are relatively unimportant for now.

328

329   A reason why this can work at all, also for quite a variety of meals, lies in the fact that there
330   is an hourly carb absorption limit of about 30g/h (reference: Dana Lewis:
331   <u>https://github.com/danamlewis/artificialpancreasbook/blob/master/8.-tips-and-tricks-for-real-</u>
332   <u>life-with-an-aps.md#heres-the-detailed-explanation-of-what-we-learned</u>). So while meals
333   might wildly vary in composition and size: What is digested, and needs insulin in the first
334   <90 minutes (when FCL tries to catch up with insulin need and differs strongly from HCL,
335   and bgAccel_ISF and pp_ISF play the leading role), will be relatively close (…for meals with
336   similar *initial* glucose acceleration and rises, anyways)
337   (The others, low carb with much slower initial acceleration and rise, are recognized
338   as different by the loop loop).

339

340 Depending on the type of meal and "aggressiveness" of your bgAccel_ISF_weight and
341 pp_ISF_weight tuning, the iob will already be so high that in the phase of decelerated glucose rise
342 towards the peak (the "last part of the rise") that no insulinReq is seen by the loop.

343

344 Therefore the **bgBrake_ISF_weight** is often unimportant (-> section 4.4)

345

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

347 A setting that is actually set too aggressive might be masked. **Tuning only works if** the effects of

348 the settings being tuned are **not** unintentionally **limited by other** (e.g.„safety") **settings**.

349

350 Also, **always look at two or three _different_ meals** before deciding whether a tuning "fits" („good

351 enough" for each of them) <u>Case Study 4.1</u> (Pizza Meal) contains, towards the end, an example

352 how you can go about tuning the _weights for various _ISF factors of autoISF.

353 You probably will have to iterate back and forth doing this for two or three different kinds of meals

354 until you find _one_ good enough set of settings _for all_ of them.

355

356 ## 4.4 bgBrake_ISF_weight

357

358 At a **low carb** meal, or an attempt at doing a **weight reduction diet**, (and probably also if you take

359 one of these novel drugs that slow meal absorption) the glucose goes up only sluggishly, and

360 iobTH should not be reached at all.

361

362 Acceleration, and the phase of strong glucose rise, are quickly over in these cases, and there is

363 mainly a decelerating bulge of insulin action that projects over the next few hours.

364

365 Now the importance of the **bgBrake_ISF_weight** comes in.

366

367 In full closed loop, the bgBrake_ISF_weight is often only about half as large as the

368 bgAccel_ISF_weight (but that would also depend on your personal diet pattern and

369 eating/digestion speed). Also here, one should approach the tuning gradually, increasing the

370 weight from small values.

371 <u>Case Study 4.2</u> shows a user example of a low carb meal managed in FCL by autoISF. (not yet

372 included)

373

374 What is very helpful for us in any case is that the loop calculates the situation every 5

375 minutes, and corrects it.

376

377 In the late stage of still rising (!) glucose, the Full Closed Loop typically sharply reduces

378 SMBs already because it is "painfully aware" of the following principal conflict:

379 - Iob (like formerly given in HCL via your bolus) must go high quickly, in order to limit

380   the high

381 • However, if there is too much insulin in the system, a hypo can happen within the
382 DIA time window because the loop can only correct to a very limited extent
383 (namely, only to the extent that it can set basal to zero).

384 Therefore, the core problem is that the Full Closed Loop must build up iob very quickly, but
385 not too much, in the initial phase of a meal, and high bg values (out of range, >180 mg/dl)
386 can not always be avoided.
387

4.5 High Glucose Values: dura_ISF_weight (and bg_ISF)

390 With **large or high fat/protein** meals, a 2nd hill of glucose will form, or a long high plateau.
391 For such situations there is in autoISF the modulation of ISF depending on bg level or duration of
392 plateau formation.
393

394 High plateaus in bg values are tuned using the **dura_ISF_weight** and associated parameters.
395 This feature is also very useful in Hybrid Closed Loop. It elegantly manages, fully
396 automatically, temporary fatty acid resistance. Please refer to other papers for details (for
397 instance, section „Late stage of meals" of "Meal Management Basics", available here:
398 https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings).
399

400 Since in Full Closed Loop we "turn up" our loop to give the maximum SMB size we can at the
401 beginning of a rise, it is crucial to **resist the temptation to continue with a particularly strong**
402 **ISF in the meal phase with the highest glucose values** .
403

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

406 • Wanting to get most of our insulin from SMBs delivered at fairly low (but beginning-to-rise)
407 bg implies that we do not make ISF weaker at low bg. Under preferences/OpenAPS
408 SMB/autoISF/bg_ISF settings we set lower_ISF_range_weight = 0.0

409 • The higher_ISFrange_weight should also be fairly irrelevant: Near glucose peak, zero-
410 temping usually prevails anyway, so the settings we try might often not be used really by
411 the loop. You probably can live with setting 0.0 there, too. Or you might set 0.1 or 0.2 to see
412 in the emulator tables where this effect, *after inputting a much higher weight*, could lead,
413 and whether *that* would be desirable (unlikely).

414 **Caution:** Investigating effects of set weights is not really possible in periods of zero-temping. Too
415 aggressive settings might not come into play most of the time. However, some *other* time they
416 might come into play, and *then* produce a hypo 1-2 hours later.
417

418   Therefore, **carefully study the SMB tab** (or better yet, do an emulator based analysis, see

419   ) **to see what the selected weights would do, if there was no zero-temping** at

420   the time. Also, try a completely different meal to see how your settings work there.

421

422   The UAM Full Closed Loop doesn't get any information from you as to how many grams of

423   carbs will be absorbed late. Not knowing when your steady-state max carb absorption

424   phase (the earlier mentioned 30g/h), and even sometimes a brief episode of insulin

425   resistance to fats, might end, the FCL will struggle to provide desired amounts of insulin,

426   facing potential hypo danger later because of the DIA of the insulin in use.

427

428   Actually, the UAM Full Closed Loop is *not completely clueless* regarding how carb

429   absorption will go on. It will work with a prediction of further carb absorption building on the

430   **carb deviation** (=hypothesis of how much got absorbed in the past 5 minute segments),

431   and phase out more carb decay in the course of the next 1 to max 3 hours. For more detail

432   see

433   https://openaps.readthedocs.io/en/latest/docs/While%20You%20Wait%20For%20Gear/Und

434   erstand-determine-basal.html#understanding-the-basic-logic-written-version (or study your

435   SMB tab info).

436

437   This UAM prediction about further carb absorption can be worse, but can also be better

438   than a prediction based on the user's „e-Carb" input in Hybrid Closed Loop.

439

440   In any case, and even when having perfect knowledge about how exactly the carbs fade

441   out in the next hours, there would still be a principal problem for the loop: Heavy insulin

442   „fire" against highs will not work immediately (depending on the insulin's time-to-peak), and

443   notably it comes with a significant hypo danger (from the „tail" of insulin activity.)

444   A big bolus, or also a series of boli, will rarely work exactly for several hours matching the

445   absorption of carbs (from what, how much and and how fast the user ate).

446

447   Once your BG sits high, neither you, nor a hybrid closed loop with all the carb info, nor your FCL

448   can work wonders. Resist the temptation to elevate the **dura_ISF_**weight very high.

449

450   The author is sceptical about using the **bg_ISF** (at least be careful, use small weight, or shut-off).

451   Highs will take time to resolve. Interestingly, an after-dinner walk can work wonders sometimes.

452

453

454

455

4.6 Tuning your initial settings

Be pro-active: **The earlier large SMBs come** (driven by bgAccel_ISF and pp_ISF) …
        Also the settings for your CGM smoothing may play a role here that you may want
        to look into at some point!
…the less high the overall increase in BG will be, and (provided you set a proper iobTH)
the lesser the risk will be for a hypo after the meal.

Therefore, put most of your FCL tuning effort into determining suitable weights for
bgAccel_ and for pp_ISF, and a suitable iobTH_percent.
        Your FCL cockpit will give you access to modulate 2 of these 3 essential
        parameters (see section 5.2.), providing you an opportunity for more research on
        the fly, so to speak.

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

However, if you come to the conclusion that **differentiated settings** for different meals or meal
time clusters, would be easier to establish and/or work better for you, you can:

- define Automations that use different iobTH and/or different bgAccel_ISF-weights for
  different rough meal-time slots in your days (see section 5.1.4)

- manually modulate FCL aggressiveness via setting temp. %profile and/or TT (see section
  5.2.2.2)

- or install and activate a user defined extra button in your cockpit for it (see section 5.2.2.3)

- or pre-program 4 different clusters in /preferences, and call them up within a second from
  the TT button in your AAPS home screen (*only after implementation of an improved cockpit,*
  see section 5.3.3.1 (4) and section 6.4.3))

After you tuned your **initial settings** well, there should rarely arise a need for "fine tuning" later,
see section 8 and case study 8.2!

4.7 Profile helper

xls based tool is still under development / needs more user data / chapter will follow later