

4. Meals: Setting ISF_weights in /Preferences

v.4.0



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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Warning regarding importance of proper profile ISFs.

Starters on autoISF FCL who are coming from using HCL with **dynamicISF** 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 what they had used as a profile ISF (often only one, e.g. coming from Autotune).

The following is important to understand, as it 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** (set in **profile** for 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. See [https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-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_V.3.33.pdf)).

- Using *that strong* value also at lower *bg*, (on the way “up” , after meal start), is very positive: We do *not* want to have a *softer* acting loop when at *lower* *bg* (which is what dynamicISF tends to do!). autoISF will, in contrast, temporarily sharpen your ISF when, at low *bg*, acceleration is detected..
- On the way down from peak, towards glucose target, a somewhat too strong ISF should 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*.
- You have no business to be much above 200 mg/dl where an *even stronger ISF* may or may not help. It sure does not help at an occlusion which is about the only reason to see super high values as an experienced looper.

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

Note: There are very much refined versions of dynamicISF that can have beneficial applications, notably in HCL.

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

When using autoISF you can – as you did in the past, e.g. around exercise, or in times of illness – temporarily modify your profile ISFs, via a **%profile switch**. Also the other two top buttons, exercise and TT, can be used to adapt to changes in sensitivity/resistance. More about that in [section 5.2.2.2](#) . But, first, spend a couple of days (if not weeks) to get your key autoISF related settings right, strictly on/for days with your normal insulin sensitivity. This is what this [section 4](#) is about.

Warning: Do not copy settings from other FCL loopers

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

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

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

Warning. Importance of starting from a well-performing Hybrid Closed Loop

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

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

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

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

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

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

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

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

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

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

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

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

One principal reason why things are difficult to analyze is, that you really can only analyze one change, and that will put you on another bg curve. So, you can never see the full effect, along more than 10 minutes, that *any* change will ultimately result in.

PS: [Section 11.4](#) describes the ultimate tool to investigate “what-if” regarding a setting change you may contemplate.

4.1 Getting started

Make sure you have studied the preceding [sections 1](#) and [2](#) on the general pre-requisites for FCL and [section 3](#) on the principal workings of autoISF.

Caution: This entire e-book is about Full Closed Looping. **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. You would have to **do extra research**, on your own data, how your bolus changes things. (See also [section 7](#), and discussion on pre-bolussing, ~2 pages down)

Make sure you have appropriately:

- **widened the SMB size restrictions** ([section 2.1](#)),
- **elevated** the max allowed ISF amplification with your set **autoISFmax** ([section 2.2](#))
- **set your iobTH%** (refer to [section 2.4](#) and if available [4.8](#))

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 behavior”**) 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 meals. Omit sweet drinks, or drink only slowly.
- Occasionally, watch the time-pattern of bg, iob (SMBs given), and insulin activity after meal start. Aside from serious “mathematical” attempts to tune settings based on data from the SMB tab (or the emulator, section 10), just watching the curves develop on your AAPS main

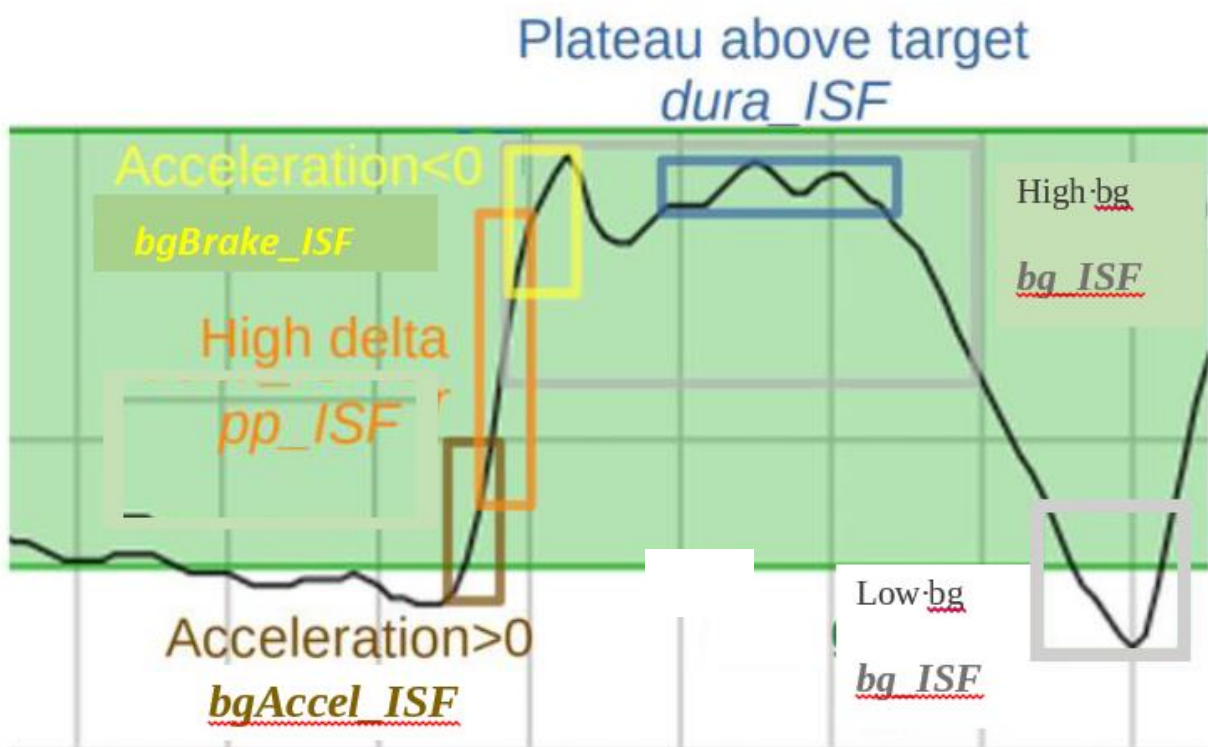
screen can, over time, give you “a feel” what settings, and eating behaviors, are benign or detrimental to good %TIR performance.

- It is wasted time to “optimize” settings based on 1 type of meal. You need a “good enough” compromise that works with your range of usual meals. See [case study 8.2](#)
- 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, note that any active TT shuts activity monitor automatically off for a while.

The core challenge of your UAM Full Closed Loop is to recognize 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:



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.

Reminder: autoISF has that advantage only if the pre-requisites ([section 1](#)) are given, notably a very fast insulin, and reliable CGM and insulin delivery (not leaking, and permanently Bluetooth connected).

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

Consult this also to help you understand how, in your SMB tab, the applied effective ISF (named **sens** there) is calculated.

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** and potentially dangerous **ways**:

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.

4.2 Meal detection and managing the initial bg rise: 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 large SMBs are requested immediately when the loop detects an acceleration in your blood glucose (bg) that is starting to rise.

209

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

213 **Insert here. BLUEPRINT ANALYSIS TOTAL IOB FOR MEAL HCL => FCL**

214 Rule of thumb: Two of the first three SMBs each should be about $\frac{1}{4}$ to $\frac{1}{3}$ the size of a previous
215 big meal bolus in your HCL „career“.

216 **Going over 1/3 would be problematic if your diet contains occasional low carb (or**
217 **only snacking), and generally of course if your CGM quality is sometimes unreliable,**
218 and might produce an artefact that could be mistaken for a meal start. Be vigilant about this
219 topic!

220

221 For hands-off FCL, your settings have to fit the whole **range of your meals** in each of your meal
222 times, e.g. should suit (nearly) all your lunches that you tend to have.

223 *Between your daily mealtime slots, your circadian ISFs make a differentiation.*

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

227

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

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

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

- 235 • You can pre-program **custom buttons for special meal (or snack) types**, with different
236 underlying FCL settings (see “cockpit”, [section 5.2.2.3](#))

- 237 • ***Skip what is in green writing:***
238 *= Drafted fragments or not implemented ideas.*
Please contribute, or wait for update with the
missing info

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

- 241 • You can **modulate FCL aggressiveness manually** making use of temporary switches
242 of %profile and/or set for a couple of minutes an odd (=>SMB off) glucose target ([section](#)
243 [5.2.2.2](#))

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

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

250 **It is certainly worth trying hard at finding a good set of ISF_weights for your meal spectrum,**

251 **to keep interventions in daily life to a minimum.**

252

253

254 In search of appropriate settings, you must keep (real-time) track of the **SMB tab** when tuning. This

255 can be impractical. You probably will end up making a lot of screenshots (quickly in the crucial

256 minutes after a SMB was given, or when *you thought it should be given*), for later analysis.

257

258 The superior method is to just copy **logfiles**

259 ... from autoISF 3.0.1 onwards, about every 2 weeks should suffice...

260 from your phone/internal memory/AAPS/logs (all zip files there), and analyze them at your

261 convenience later, using the **emulator** (see [section 10](#); used e.g. in last pages of [case study 4.1](#)).

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

263

264 Already when tuning the bgAccel_ISF_weight it can become evident that safety restrictions (as

265 discussed in [section 2](#)) must be **widened** further:

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

271 In the end you should **not set these safety limits too tight**, so “nudging” aggressiveness by

272 another 10 or 20% from your cockpit, later, will not bounce into restrictions.

273

274 On the other hand, setting **narrower** restrictions for max allowed SMB size can also become

275 necessary:

- 276 • You don’t want your loop bounce, regardless of the carb load, “immediately” into your iobTH
- 277 limit (and up to 30% above), which is not desirable if your meal spectrum is very varied
- 278 • Poorer CGM quality demands narrower restrictions, too, for safety reasons.
- 279 • If you use a 1-minute CGM (Libre 3) please observe [section 1.4.2](#)

280

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

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

285

286 **Early strong iob** also eases the tuning task for the subsequent phases of the meal, because
287 there is, then, largely zero-temping, as well known from HCL-times after your administered bolus.
288 Also, the lower and shorter lasting the glucose peak, the lesser the hypo danger from the activity
289 tail of SMBs given *when* glucose was „stuck“ high.

290

291 bgAccel_ISF_weight is set default to zero in autoISF.

292 **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.
293 From my (very limited) overview, many use around 0.2, and possibly even higher if their hourly
294 basal rate is 0.1U or lower. ([Consult section 4.8 when available](#)). Do not be tempted to rush this
295 setting by using large jumps in adjustments.

296 [How changing the _weights influences the resulting calculated insulinRequired](#)

297

298 To get a feel for how changing the _weights influences the resulting calculated insulinRequired, it is
299 best to start cautiously and just do 10 to max 20% steps up, and watch out for the effects. Doing
300 similar step sizes should yield about similar effects each time.

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

302 *If your profile_ISF is 40 mg/dl/U and with bgAccel_ISF_weight = 0.20 you saw acce_ISF*
303 *factor of 1.31, this would ((if the acce influence dominates and is used as effective ISF))*
304 *lead to the effectively used ISF of $40/1.31 = 30.53$ mg/dl/U. For an intended correction by –*
305 *10 mg/dl the insulinRequired would calculate to $10 / 30.53 = 0.328$ U.*

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

307
$$\text{acce_ISF} = 1 + \text{bgAccel_ISF_weight} * \text{internalFactor}$$

308 *before* $1.31 = 1 + 0.20 * iF \Rightarrow 0.31 = 0.20 * iF \Rightarrow iF = 1.55$

309 *after* $? = 1 + 0.16 * iF \Rightarrow ? = 1 + 0.16 * 1.55 = 1.25$

310 *New effective ISF would be $40 / 1.25 = 32.05$ mg/dl/U. For an intended correction by – 10*
311 *mg/dl the insulinRequired would calculate to $10 / 32.05 = 0.312$ U, which is 4.9% less.*

312

313 *Example 2: Going from bgAccel_ISF_weight of 0.2 to 0.10 (50% less; or doubling in the*
314 *other direction).*

315 *If your profile_ISF is 40 mg/dl/U and with bgAccel_ISF_weight = 0.20 you saw acce_ISF*
316 *factor of 1.31, this would ((if the acce influence dominates and is used as effective ISF))*

lead to the effectively used ISF of $40/1.31 = 30.53$ mg/dl/U. For an intended correction by –
10 mg/dl the insulinRequired would calculate to $10 / 30.53 = 0.328$ U.

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

$$acce_ISF = 1 + bgAccel_ISF_weight * internalFactor$$

before $1.31 = 1 + 0.20 * iF \Rightarrow 0.31 = 0.20 * iF \Rightarrow iF = 1.55$

after $? = 1 + 0.10 * iF \Rightarrow ? = 1 + 0.10 * 1.55 = 1.155$

New effective ISF would be $40 / 1.155 = 34.63$ mg/dl/U. For an intended correction by – 10
mg/dl the insulinRequired would calculate to $10 / 34.63 = 0.289$ U, which is 12 % less
(going the other way, 0.328 is 13.5 % more).

Example 2 (-50%) reduces _weight 2.5 times lower than example 1 (-20%), and the resulting
effect (-12% vs. -4.9% insulin Required) is also factor 2.5 different.

Note: “Your” internal factor “iF” might differ; for sure it is very different between the
various ..._ISF components. (Also, never forget to look into how other .._ISFs play into the
effective_ISF which overall results).

Ideally, one should set the bgAccel_ISF_weight such, that for meals that are in the **lower** (!) range
of the “fast **carb load**” of your cluster, the necessary insulin supply is already approximately
provided with 3 SMBs.

The glucose curve, at such meals, begins to flatten early in this SMB phase, so a de-celeration
(**braking**) follows very soon (-> [section 4.4](#)).

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

After the peak, in the late stage of *falling* bg, the glucose curve is like an accelerating
parabola again. The algorithm tries to evaluate when and at which bg level complete
digestion of the meal and a bg minimum will result. Insulin required to stabilize around
target bg is usually very small, 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.

350 4.3 Managing strong bg rises: pp_ISF

351

352 With **higher carb load** meals, or meals that come with a sweet drink, the acceleration phase will
353 last longer, and bg will rise further, which will require a higher insulin supply.

354

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

357

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

360

361

362 Tune your **pp_ISF_weight** *after* you have set a halfway suitable (not too aggressive)
363 bgAccel_ISF_weight. You now should check meals in the upper spectrum of your g carb load, and
364 carefully start with a starting value for *pp_ISF_weight* of 0.005. Observe the reactions and check
365 the SMB-tab before you increase it with care for the next days.

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

368

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

372

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

375 (Reference: Dana

376 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)
377 [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

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

380

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

385

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

388

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

392

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

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

395

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

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

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

400

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

404 • [Case Study 4.1](#) (Pizza Meal) contains, towards the end, an example how you can go about tuning
405 the _weights for various _ISF factors of autoISF.

406 • [Case Study 8.2](#) shows that it is not worth it to seek “optimized” settings based on just one meal.

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

409

410

411 4.4 Sluggish rise towards bg peak: bgBrake_ISF

412

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

417 In case you *always* do very slow absorbing meals, you could of course also adjust your iobTH setting
418 low enough to suit your *uniform* situation.

419

420 Acceleration, and the phase of strong glucose rise, are quickly over at slow-absorbing meals, and
421 there is mainly a decelerating bulge of insulin action that projects over the next few hours.

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

423

424 Note that in some data outputs you will see only “**acce_ISF**” results. In case of positive acceleration,
425 these are driven by the bgAccel_ISF_weight setting, and results are >1.

426 In case of **negative acceleration** (decelerating rise), **bgBrake_ISF_weight is applied**, , and results
427 are < 1. (Example see in graph in [section 10.3.3.3](#)).

428

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

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

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

437 Likewise, if your initial bgAccel_weight is set so strong that your first SMBs catapult you over the
438 iobTH, no matter what type of meal: Then you must **first** find a reasonable setting for this parameter,
439 one that works “good enough” to control your carb loaded meals, but still leaves room for milder loop
440 response at low carb meals.

441

442 In case you cannot quite get all the ISF_weights “right” so the occasional low carb meal will not get
443 over-treated: Avenues to adapt your loop aggressiveness are discussed in section 5. For indstance
444 you will be able to (if needed);

445

- 446 • use a temp. reduced %profile
- 447 • temp. lower iobTH or bgAccel_ISF_weight
- 448 • construct for yourself an extra snack or low carb button (“DIY cockpit”) with an underlying
449 suitable Automation

450

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

453

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

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

461

462 4.5 High Glucose Values: dura_ISF and bg_ISF

463

464 4.5.1 dura_ISF

465

466 With **large or high fat/protein** meals, a 2nd hill will form in the bg curve, or a long high plateau.

467 For such situations, autoISF features the modulation of ISF depending on bg level and duration of
468 **plateau** formation.

469

470 Conditions for duraISF to become active:

471 1) glucose is varying within a **+/- 5% interval** only;

472 2) the average glucose (*dura_ISF_average*) within that interval is **above target**;

473 3) this situation lasted **at least for** the last **10 minutes**

474 Effect: Formula is given in section 3 (-> Quick Guide Github/ga-zelle)

475 4) The strengthening of ISF is stronger the longer the situation lasts, and the higher the aver-
476 age glucose is above target:

477 5) This can be individually tuned by the **duraISF_weight to automatically manage** high plat-
478 eaus in bg values

479

480 This feature is also very useful in Hybrid Closed Loop. It can be used to elegantly manage,
481 fully automatically, a temporary insulin resistance from fatty acids. Please refer to other
482 papers for details (for instance, section „Late stage of meals“ of “Meal Management
483 Basics”, available here: [https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-](https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings)
484 [settings](https://github.com/bernie4375/HCL-Meal-Mgt.-ISF-and-IC-settings)).

485

486 Set a **start value of 0.2** for your dura_ISF_weight, and increase only cautiously with an eye on
487 hypo prevention 2-3 hours later. Fine tuning this parameter only makes sense **after** you tuned your
488 bgAccel_ISF well (so your thin yellow insulin activity curve shifts as far to the left, towards meal
489 start, as possible, which will lower bg peaks and ease the job for dura_ISF).

490

491 To limit the danger of going low, it can make sense to design
492 an Automation which pauses the delivery of more insulin.

493

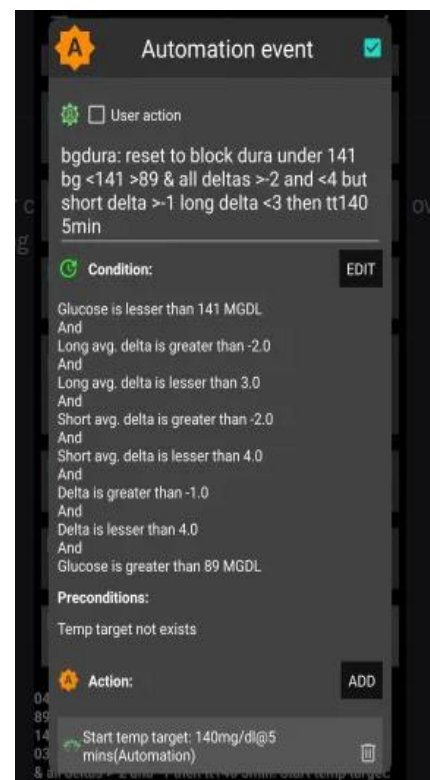
494 This one was suggested by Alex999

495

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

499

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



503

504 4.5.2 bg_ISF

505

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

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

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

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

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

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

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

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

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

- 535 • what the selected weights **would** do, **if** there was **no zero-temping** at the time, and
- 536 • whether you bump into a set limitation already (if your bgAccel_ISF_weight makes you
537 exceed allowed max. SMB size, then further tuning your settings only makes sense with

either allowing bigger SMBs, or limiting bgAccel_ISF_weight to a lower number at which you will not frequently bounce into the SMB limit)

- at which **other** times (rather than the one you currently look at and try to improve) that selected setting might backfire

Very important: Also try a **completely different meal** (within your common spectrum), to see how your settings work *there*.

- Iterate between 2 or 3 such meals to find one set of settings that works *good-enough for all*. That should be possible.
- If you can't make it work for certain meal types, see [sections 4.7](#) and [5](#). what you can do then.

4.5.3 How your "UAM" concludes insulin need for your un-declared carbs

The UAM Full Closed Loop doesn't get any information from you as to how many grams of carbs will be there, for absorption. Not knowing when your steady-state max carb absorption phase...

- the earlier mentioned 30g/h, or
- with gastroparesis, or if on GLP-1 drug treatment, probably on a lower g/h level
- sometimes prolonged ("faked") by a brief episode of insulin resistance to fats

...might end, the FCL will struggle to provide desired amounts of insulin, facing potential hypo danger later (because of the DIA of the insulin in use).

Actually, the UAM Full Closed Loop is *not completely clueless* regarding how carb absorption will go on.

It will work with a **prediction** of *further* carb absorption building on the **carb deviation** (=hypothesis of how much got absorbed in the *past* 5 minute segments), and phase out further expected carb decay in the course of the next 1 to max 3 hours. For more detail see

<https://openaps.readthedocs.io/en/latest/docs/While%20You%20Wait%20For%20Gear/Understand-determine-basal.html#understanding-the-basic-logic-written-version> (or study your SMB tab info).

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

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

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

578

579

580

581 4.5.4 Conclusion on managing bg highs

582

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

585

586 Resist the temptation to elevate the **dura_ISF_weight** very high.

587

588 The author is sceptical about using the **bg_ISF** in Full Closed Loop:

589 • In FCL you probably can afford to shut it entirely off via setting both related **_weights** to 0.0.

590 • At least be careful, use small **ISF_range_weights** and check whether you are happy with
591 the contributions to effectively used ISFs

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

595

596 bg highs will take time to resolve.

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

598

599 4.6 Tuning your initial settings

600

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

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

603 ...the **less high** the overall increase in BG will be, and (provided you set a proper **iobTH**)

604 the **lesser** the **risk** will be **for a hypo** after the meal.

605

606 Therefore, **put most of your FCL tuning effort into determining suitable weights for**

607 **bgAccel_** and for **pp_ISF**, and for finding a suitable **iobTH_percent**.

608

609 Later, your FCL cockpit will give you access to **temporarily modulate** these essential
610 parameters (see [section 5.2.](#)), providing you an opportunity
611 • in your tuning phase, for more research on the fly, so to speak
612 • everyday, for temp. adaptations to altered insulin sensitivity, or to special
613 disturbances (if you occasionally see a need).

614
615 After you tuned your **initial settings** well, there should rarely arise a need for “fine tuning” later,
616 see [section 8](#) and [case study 8.2!](#)

617
618 The experience of the author is that it is possible to tune the above mentioned weights for very
619 different meals in such a way that the glucose almost always remains acceptably in range.

620
621 However, if you come to the conclusion that **differentiated settings** (for different meals or meal
622 time clusters) would be easier to establish, and/or work better for you, the following sections
623 suggest many options you could try and use.

624

625

626 4.7 Covering more complex scenarios

627

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

629

- 630 • Depending
- 631 ○ how satisfied you are with your initially reached result, or which **more extreme**
632 **meals** (smaller? faster/slower carbs? totally different fat/protein content?) you would
633 like your FCL to manage as well, or
- 634 ○ whether you seek **temporary** adjustments that **make your FCL act more**
635 **aggressive, or softer**

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

637

- 638 • It is suggested to do **major exercise** still *in your hybrid closed loop* setting, *until* you have
639 your FCL up and running for meals on normal days with no or only moderate exercise.
640 Later, implement extras as discussed in [section 6](#) to fully implement your FCL.

641

642 To deal with **different disturbances than presented by the meal spectrum you were**
643 **calibrating for**, there will be **temporary modulations** of your FCL possible.

- 644
- 645 • Manual, making use of the top 3 buttons (%profile, exercise, TT; TT; [section 5.2.2.2](#)) or
 - 646 • Semi-automatic (user triggered), aided by Automations you would set up, with a user
647 defined extra button in your cockpit for it ([section 5.2.2.3](#)) or
 - 648 • fully automatic (via pre-defined settings and/or Automations that e.g. that use different
649 iobTH and/or different bgAccel_ISF-weights for different rough meal-time slots in your
650 days: [section 5.1.4](#))
 - 651 • In future autoISF versions we could also pre-program 4 different clusters in /preferences,
652 and call them up within a second from the TT button in the AAPS home screen (*only after*
653 *implementation of an improved cockpit, see [section 5.3.3.1 \(4\)](#) and [section 6.4.3](#)*)

654

655 So, while FCL is about fully automatic cruising, your **AAPS main screen** will serve you as your
656 cockpit to check how everything is running, and to aid your loop manouvering through some
657 special disturbances.

658

659 In the **SMB tab** you can see how the autoISF modulation of ISF is overall applied to arrive
660 at the actually used **effective ISF (“sens”)**: See also example given in [section 5.4.5](#)

- 661
- 662 • In the SMB tab, *above the “start autoISF.” line*, the profile ISF is given (“ISF
663 unchanged”), eventually with adaptation by activity monitor (“adjusting ...ISF
664 from ... to ..”) or by a TT (“adjusting ...ISF from ... to ..”) or by a %temp. profile set
665 (still called “ISF unchanged” then, meaning unchanged yet by autoISF).
 - 666 • *Then* follows the autoISF section, explaining in detail how the recently encountered
667 bg curve characteristics suggest adaptations, and what overall the conclusion is
668 (“final ISF factor”, calculated following the flowcharts as explained in detail in
669 section 03.).
 - 670 • *Below the autoISF section*, the effective ISF (sens) results from dividing the
671 (unchanged or adapted) ISF *prior to* “start autoISF”, with the determined “final ISF
672 factor” at the end of the autoISF section of the SMB tab.

673

674

675 **4.8 Profile helper**

676

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