5. Modulation of autoISF aggressiveness. V 2.4-

Once the initial tuning according to <u>section 4.</u> is done, you are ready to use autoISF for your fully automated meal management.

You will have three major *other* challenges to manage:

- recognize and manage (partial) occlusions, or other technical (CGM or BT related) obstacles (see <u>section 2</u> on pre-requisites of FCL, and related case studies)

- deal with times when insulin given by the loop must be restricted (e.g. a snack could be "misinterpreted" as a meal)

- deal with times when the loop should be set "milder" as a precaution (e.g. nights; or in an exercise context).

How big the remaining challenge is depends very much on your individual lifestyle. <u>Sections 5</u> and <u>6</u> discuss this in more detail.

In order to run the loop fully automatically around the clock, the times *outside* the meal blocks must also be precisely analyzed, and solutions to problems (if any) must be sought.

It is up to every user to decide where to draw the line.

- With a technically well functioning system, moderate meals, moderate or no exercise, moderate %TIR expectations and a bit of mindfulness it should be possible to go into Full Closed Loop 24/7, after working through, and observing, <u>sections 1-4</u>.

- Especially if you are a bit shy of using the emulator for really detailed analysis, it is likely that you will not hit *one* real good system calibration (<u>section 4</u>) for your *entire range* of diets.

  In that case you will occasionally run out of range, and your options to prevent, react, or improve are

- o   accepting a few % higher time outside range for that day (and, if feasible, in the future avoiding what seemed to have caused it)

- o   taking a snack (whenever you tend to go low from the "tails" of insulin activity that was required to fight a peak)

- o   doing a manual override (if you can think of one in time, to manage the problem manually)

- o   temporarily resorting to the well-known hybrid closed loop.

Instead of accepting such instances, you could launch "improvement projects"

- that refine your initial tuning (section 4.)

- that make you and your FCL loop fit to manage an increasing number of disturbances either automatically, or via a user intervention (sections 5-6).

To tailor the loop's response to disturbances *other-than* your major meals probably will require specific **modulation of the aggressiveness** that you set according to section 4 for your meal management.
There are many avenues to achieve this. The main ones, that are also easy accessible via Automations in AAPS, are:

- temporary shut-off SMBs (odd-numbered target)

- temporary reduce bgAccel_ISF-weigh

- temporary reduce iobTH

- temporary reduce set %profile

- temporary set higher TT (especially in connection with exercise mode)t

In setting up your FCL, you now have another difficult and time-consuming job at hand, to define solutions for any of your „other" situations (outside of meal management) that tend to drive glucose outside of the desirable range.

- In section 5.1 we explore avenues towards *fully automated* management that in daily life will require no user intervention at all.

- In section 5.2 and 5.3 we will look at solutions that involve an easy *user interaction like a data entry or button push.*

5.1 Fully automatic modulation of FCL aggressiveness

The following subchapters describe set-ups you may want to use for allowing **completely hands-off FCL in as many daily situations as possible.**

5.1.1 autoISF generally switched off outside of meal-time windows

If, aside from having to bolus for meals, your hybrid closed loop was running pretty well *without* other interventions from your side, you could continue to run in that mode, and just focus your new autoISF FCL on management of meals.

> In your initial transitioning phase this approach makes a lot of sense, and even by focusing autoISF on just a sub-set of them, like only dinners.

> Also in the long run this avenue is taken by many FCL users for the night times, "hanging on" to their well performing hybrid closed loop with standard oref(1) SMB+UAM

For this, you define Automations

- that set meal time windows in which "Enable ISF adaptation by glucose behavior" (autoISF) is turned on in AAPS preferences/OpenAPS SMB

- *or:* that turn *all* autoISF's ISF modulations (*or* just *bgAccel_ISF*) off in time windows in which surely no meal occurs. For instance, you can go for all nights back into your Hybrid Closed Loop, as you had before.

Other early DEV AAPS variants (see <u>section 13.3</u>) all work with meal-time windows. The window is either set by time of day in the settings, or it always must be „set" by the user via giving a mandatory small pre-bolus before any meal starts. **Outside** of these time windows, these loops then runs with less aggressive SMBs like oref(1) SMB+UAM in AAPS Master. This mode is not really FCL, but an advance over traditional HCL that often achieves satisfying degrees of automation and performance.
The term **Meal Announcement** (MA) is often used to label this closed looping mode. Trigger to set a meal time window could also be a pre-bolus given by the user, a carb entry made, an EatingSoonTT set, or a meal announcement button pushed.

Note: Outside of the meal time windows you would be in hybrid closed loop. To the extent you rarely face disturbances (aside from meals), you could be looping in full automatic mode around the clock,

Your temp. "autoISF shut-down" (exiting autoISF FCL = shutting off "Enable ISF adaptation by glucose behaviour") is meant to prevent problems from the loop *over-reacting* to bumps in the glucose curve in times of day (night) when standard oref(1) performance is sufficient.

A very good alternative to fully resorting to Hybrid Closed Loop is "taming" the FCL via a night time SMB shut-off (see next section 5.1.2).

5.1.2 Odd-numbered *profile* targets used to block SMBs

An alternative route of preventing the FCL loop from over-reacting to bumps in the glucose curve would be to make use of the option to temporarily shut down SMBs

> Ensure the even/odd logic in the settings is toggled on in Preferences> openAPS SMB> autoISF settings> smb delivery settings>: "Enable alternative activation of SMB depending on profile target" ON.

In time blocks with an odd-numbered profile target you can prevent any SMBs being given by your loop. The (unchanged) aggressive settings then can only translate within the limits set by %TBR possible.

This will very much slow down any more insulin being given, and is an excellent solution for night times, especially if you occasionally experience compression lows.

> Alternatively, you could use the new included options for Automation Conditions and temporarily tune your bgAccel_ISF_weight much lower (section 5.1.4).

> Yet another alternative was already presented (section 5.1.1) = to go into hybrid closed loop for the night.
> That is possible to do with SMBs available (without them getting boosted via autoISF), and, for a long time, was the author's favoured solution for the nights.

> But, my current favourite builds on the method of this section (5.1.2, odd profile target provides SMB shut off), but then allowing some, automatically triggered when needed:

139 In case you occasionally do have nights that would benefit from a couple of SMBs (to treat temp.

140 highs from a late fatty pizza, raclette and such): Define suitable Automations like the two „night"

141 ones in this *example:*
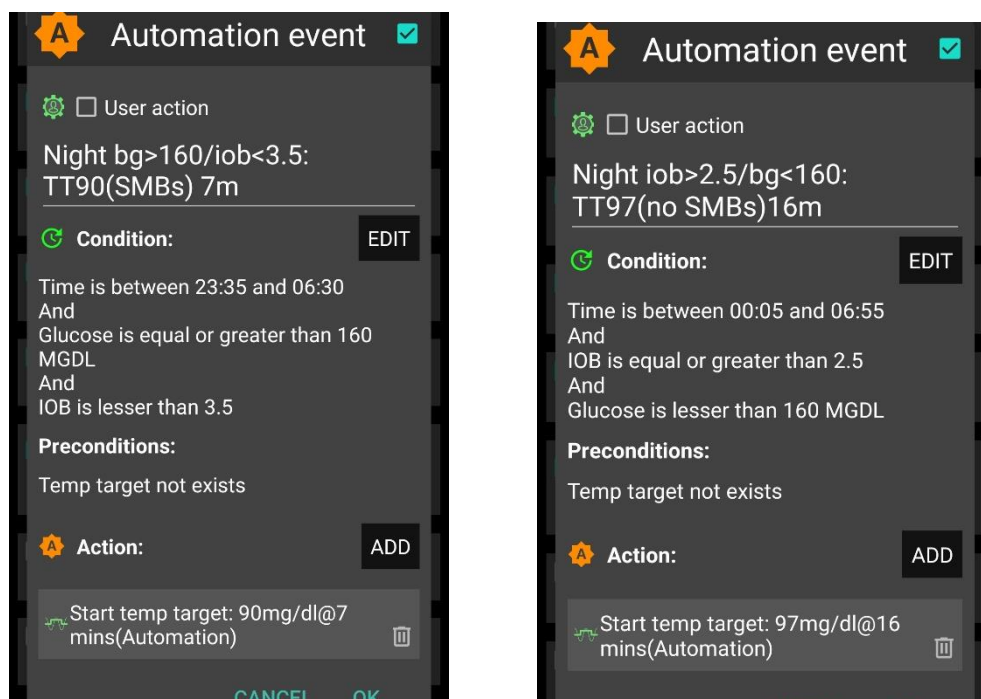
142
143

144 Never underestimate the „trickyness" of getting your Automations „right".

145 With your thought-out Automations in place, night data need to be analyzed to see

146 • whether the bg and iob <u>limits</u> defined in the given example work sensibly four *<u>your</u>* data

147 pattern

148 • whether the TT <u>duration</u> is chosen appropriately

149 • how swapping the <u>sequence</u> in which the automations appear in the Automation list would

150 lead to different SMB impacts.

151

152 5.1.3 Odd-numbered *temp*. targets (TT) set via Automation used to block SMBs

153

154 A widely used Action that strongly modifies how fast your FCL can add more iob is setting an **odd**-

155 numbered **temp. glucose target** which makes the loop operate without giving any SMBs (%TBR

156 modulation only).

157 Ensure the even/odd logic in the settings is toggled on in Preferences> openAPS SMB>

158 autoISF settings> smb delivery settings>: "Enable alternative activation of SMB depending

159 on TempTarget" ON.

160

161 So, from patterns you find in YOUR data, at times where you want your loop act differently, you

162 need to carve out Conditions that describe the respective situations (and either *for how long* it

163 typically lasts, or at which *other* Conditions you want your loop get back to default FCL operation).

164 An odd TT is often set for an *anti-hypo* snack *or sports* snack. In both instances, you do not want
165 SMBs to quickly counter act.
166   In case of *sweet "fun"* snacks, this is entirely different -> <u>section, 5.2.1</u> or for regular snacks
167   (*e.g.at school break*) see next <u>section 5.1.4</u>
168
169 5.1.4 Automatic differentiation of FCL aggressiveness using Automations
170
171 **Personalized Automations** tailor the loop exactly to **YOUR** data so **fully automated** handling of
172 situations with **different aggressiveness** of the loop can be made.
173
174 From, autoISF 3.0 onwards, also the following parameters are provided as Condition and/or as
175 Action for defining YOUR Automations:

176 - Enable ISF adaptations by glucose behavior => Allows temp. ON/OFF for the key ISF
177   modulation parts of autoISF (and, as a result, will usually decrease loop aggressiveness)

178 - Trigger/set iobTH percent => Keeps default aggressiveness, but only until a iob threshold
179   (that your Automation modifies) is surpassed (which is when any further SMBs will be
180   blocked blocked)

181 - Trigger/set bgAccel_ISF_weight => Modifies the default aggressiveness of just the
182   acceleration component

183
184 To set up suitable Automations, you first must **analyze patterns** you find **in YOUR data**, at times
185 (or geo-locationa, or bg and iob patterns that point to a problem …) **where you want your loop**
186 **act differently**, to carve out Conditions that describe the respective situations (and either for how
187 long it typically lasts, or at which *other* Conditions you want your loop get back to default FCL
188 operation).
189
190 A variant of this mode is to define several windows in which autoISF aggressiveness
191 (bgAccel_ISF_weight) and/or iobTH are automatically set differently

192 - for different meal time slots of your day –

193   (*Breakfast at home, school lunches, school intermission snacks, dinners at home* could for
194   example all deserve special settings regarding ISF_weights and iobTH).

195 - or even for a geo-location etc –

196   (*School lunches, or mother-in-law visits, would be examples*).

197
198 Unless your meals differ vastly in size and in fast carb content all this may not be needed.

199 Still, personalized Automations might help ease your initial job of setting the various ISF_weights,

200 and a best-suitable iob_theshold_percent that would work "always".

201

202 5.1.5 Automatic adjustment of FCL aggressiveness via the Activity Monitor

203

204 With the autoISF variant of AAPS you can make use of your smartphone's **stepcounter** and use it

205 to fully automatically adjust insulin sensitivity ratio to **activity level in the past minutes to one**

206 **hour** time frame.

207

208 This feature comes with yet another little tuning opportunity, in which you study your body's

209 response to light exercise (like walking) or to not moving at all (like desk, couch), and select

210 appropriate settings which, in the future, will automatically adjust insulin delivery to suit activity

211 state of the past minutes (up to 1 hour).(AAPS Preferences/OpenAPS SMB/Activity modifies

212 sensitivity/ -> set **two scaling factors**.)

213

214 This autoISF feature (new since V.3.0) is much quicker responding than Autosens or dynamicISF

215 to adjust insulin sensitivity to your current „lifestyle state".

216

217 For loopers who do not have huge variations in exercise levels in their everyday lives, this feature

218 might fairly much close the gap towards being able to do a 24/7 hands-off FCL.

219

220 Sections 3.5 and 6.5 describe the Activity monitor in more detail.

221

222 5.1.6 Pro/con completely hands-off Full Closed Loop

223

224 To stay 24/7 in a completely „hands-off" FCL can be a realistic goal with autoISF 3.0 if besides

225 meals also some special challenges, as discussed in this section 5.1, were analyzed and could be

226 addressed.

227

228 Clearly it depends very much on your lifestyle, and how interested, willing, and capable you are to

229 recognize, deal with, (and in the future avoid?) situations that get you outside of your desired %TIR

230 on occasion.

231   So, this is also about what %TIR you are aiming at, and can accept, as it averages out for

232   the week, for instance.

233

234 Everybody must weigh for her/himself

235   • how much **upfront effort** to put into the setting up process for getting it all 100% automatic

- **or** whether to take an **easier start, with a couple of situations left to take care of when and as they arise in daily life**

Also, even if a principal capability for a fully automatic running FCL is given, this still means that

- the user should be knowledgeable about what exactly is going on, and

- have a principal capability to „nudge", or to take over in a manual mode.

In the sections that immediately follow, we present the options to nudge or temporarily take over from the AAPS home screen which will be serving as your **FCL cockpit:**

- Section 5.2 describes how you can use available "buttons" from your AAPS home screen, and how to complete it towards a suitable DIY FCL cockpit, for an even better FCL experience.

- Section 5.3 describes how you might be able to manage "disturbances" even better (with more convenience) with an improved FCL cockpit in the future. (**No need to read** any of the green lines, unless you are interested in contributing to define/design/program further improvements)

5.2 Modulating aggressiveness manually, from the DIY-FCL-Cockpit*

   * Like in the airplane cockpit: Cruising in full auto mode should involve having an eye on the instruments, and on potential disturbances ahead in the environment.

In section 4. we dealt with major meals. In section 5.1 we looked into fully automatable manage-ment of other situations. Life in Full Closed Loop can become extremely easy then…

However: Other **disturbances** might come up, that:

- are not noticeable in-time, or foreseeable, by the loop (*e.g. your plan to start exercise in an hour or two*), but **that influence sensitivity dramatically** and therefore require temporary non-default settings in order to remain in-range, and/or

- **require** a different "starting point" regarding iob and bg, which translates into **a different iobTH** that should **temporarily** be set much lower (*in case of exercise*) or noticeably higher (*e.g. with very fast absorbing carbs in a sweet snack "sin"*) .

In <u>section 5.1</u> we looked into ways to automate also a modified loop response to *foreseeable* situations (tied to a time of day, geo-location etc), or to those *the loop could recognize* (with enough time to react).

Other „disturbances" might come up, and you must find an easy way to

- call up a pre-programmed routine for automatic management, with adjusted aggressiveness, or:

- manually tweak a setting or two, to temporarily adjust the aggressiveness

- There may also arise a desire to just exit the FCL mode, and be your own captain for mastering a special situation.

For peace of mind, to learn, and to stay informed (especially so in your initial tuning phase, or when your glucose curve goes in unexpected ways) we also must be able to

- find the key parameters that frame and drive the recent and upcoming loop decisions.

All this is facilitated within seconds right from the AAPS home screen, serving as a **FCL cockpit** after you built a couple of DIY cockpit features via Automations (as described below and in <u>case studies 5.2</u> and <u>6.2</u>):

    Thoughts went also into how to improve the cockpit in future releases, see <u>section 5.3</u>

5.2.1 Status recognition

Before considering any manual interventions into the ongoing FCL, you should be aware what the current mode of action is, and hence which button eventually to fine-tune or lever to switch, in order to adjust to the disturbance you see coming up.

See <u>section 5.4</u>

5,2.2 Manual interventions from the (DIY-) FCL cockpit

Trouble with all these is, not to forget to set back manually, too   (=> better solutions in 5.3)

5.2.2.1 Temporary tuning of FCL aggressiveness via temp. %profile or TT settings

The set **% profile** multiplies with both, the ISF resulting from autoISF, and also with the default iobTH you have set, so both are nicely modulated in a linear way with the % temporarily chosen

306

Just taking profile e.g. to 110% for an afternoon might be an easy way to explore whether you might benefit from 10% more "aggressiveness" in your core settings for lunches (like bgAccel_ISF_weight). Make sure, though, that the extra 10% are not cut away by set safety limits.

A lowered (relative to profile glucose target) temporary **bg target** (**TT**) signals lowered sensitivity (more insulin need), and an elevated TT (as often used with exercise) increases sensitivity and hence works in the direction of a lowered % profile to also reduce insulin given by the loop.

Moreover, the **exercise button** (top center on your AAPS home screen) can be activated (turns yellow, then). This will **further boost** how your set TT elevates the resulting ISF, and sharply lowers iobTH, as often desired for sports. See).

5.2.2.2 Making temporary changes in settings made in AAPS/preferences/Open APS SMB

Going into AAPS/preferences/Open APS SMB allows to:

- set milder or stronger …_ISF_weights

- set different iob_threshold_percent (or iobMAX)

- elevate or lower the SMB_delivers_ratio

- limit or expand max. allowed SMB size

- change the the even <-> odd logic for SMB on/off

Doing temporary changes in AAPS/preferences should be the exception because
- they require multiple steps, including entering a password
- you will often forget to set everything back to default a couple of hours, or minutes, later

5.2.2.3 Triggered Automations: Grey extra DIY cockpit buttons for pre-programmed "responses"

Recognizing conditions for fully automatic handling by the loop may not be not possible, or come too late for the loop to act on. Examples would be
- *exercise:* Minimum an hour before starting "the loop should know" to be able to lower iob and elevate bg by the time exercise starts.

339 • *snacks*: High carb snacks, sweets, consuming ice cream or having a sweet drink comes
340   with the problem of even steeper glucose rises, but overall a lesser insulin need, compared
341   to major meals (for which we tuned our FCL according to section 4).
342

343 This not necessarily implies that snacks need different settings than a meal. After all, autoISF
344 was designed to act to all available data, especially to where the developing glucose curve is
345 headed. So, depending on your effort to set parameters for a broad variety of meals (notably:
346 how well you avoid to invariably bounce fast against your iobTH), you might be able to accom-
347 modate low carb, snack, and major meals with *one* set of settings.
348

349   In FCL autoISF, this is a bit more difficult than in HCL autoISF applications, because FCL
350   involves revving up iob supply (largely via big bgAccel_ISF-weights) often too much to be
351   balanced by just a snack getting absorbed.
352

353 For that reason, or just for increased comfort and safety, you might want to differentiate, and make
354 use of what follows for the *sweet snack* example.
355

356 Tuning aggressiveness
357 Key is that a sweet snack likely benefits from even more aggressive initial FCL
358 performance than the meals in your normal spectrum of diets require.
359 Therefore, you could set
360   • a higher **temp. profile%** and/or

361   • a temp.elevated **bgAccel_ISF-weight** (see screenshot of my Automation).

362   • a **low temp. target** (76 for instance; this additionally helps maximize the first SMBs
363   that will automatically be triggered at detection of acceleration)..

364

365 When first defining and testing this Automation, also check:
366   • that the safety limits as discussed in section 2 will not block the intended elevated
367   aggressiveness

368   • SMBs will not get outrageously big and iobTH sometimes exceeded by too much

369   Note that "the last SMB" is allowed to overshoot the effective iobTH by 30%
370

371 Limiting iob
372 For "just a snack", total insulin need will be lower than for a meal.

373   If you would just have your sweet drink, and your meal-oriented FCL would "attack",

374   iob likely would become too high, and a glucose rollercoaster would start, with you

375   needing to consume more =>

376 If you just have a snack, or drink a glass of juice, you can lower the **iobTH_percent**
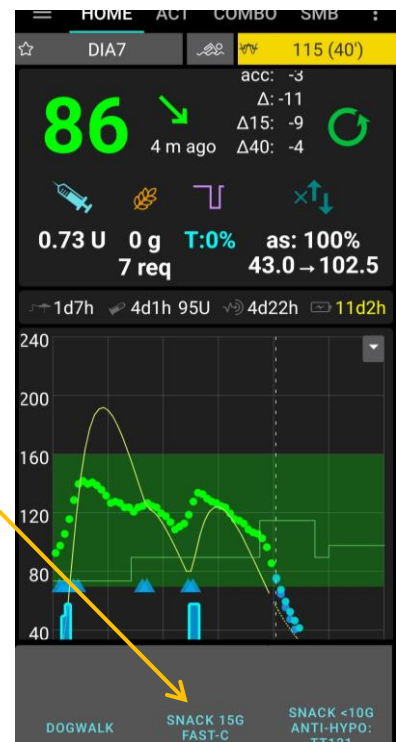
377 accordingly.
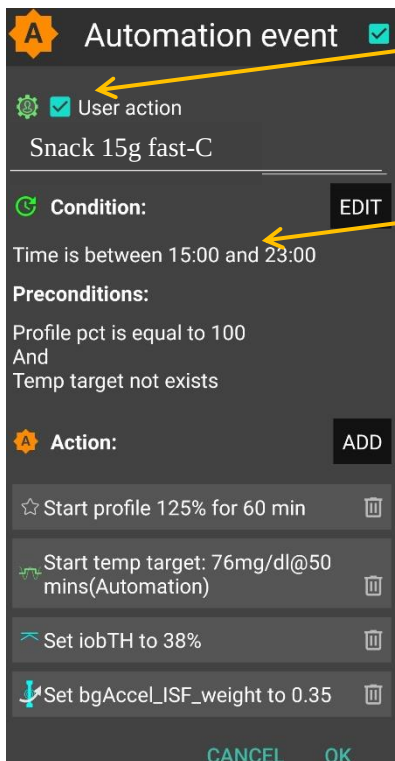
"User action" is always ticked-on

This will, in the defined time space ..

..offer the "DIY cockpit" button..

..which I must press any time (~90…30 minutes) before my snack.

Note: Make sure that iobTH and bgAccel_ISF_weight revert to default afterwards

378

379

380 So, this can be a little **extra "project" when setting up your FCL**.

381 You need to research your snack habits (if any), and over time find out which settings in

382 the snack-related Automations work well.

383

384 **In everyday life** you **then just** must **press the related button in your cockpit** (which is

385 not time critical at all, except it should be clicked *latest* a couple of minutes after you took

386 the drink or snack).

387

388   If you consume more, and also eat something with your sweet drink, this will more

389   resemble a full meal… however, with unusual amounts of fast carbs.

390

391   Note: Pressing your snack button *a second time* would ***not*** help because the

392   lowered iobTH does not allow iob going high enough. So you are better off just

393   letting your normal FCL meal routine run, after your snack mode expired.

394

Other options when snacks keep extending would require a manual modulation regarding %profile and/or bgAccel_ISF, but keeping the full default set iobTH_percent, or even elevating it (refer to section 5.2.3). If that happens often, define for yourself an extra User action Automation for a bigger snack (= another grey DIY cockpit button).

Installing the DIY cockpit button

In the related Automation, just keep the "User action" box clicked at all times, and define in the Conditions when you want to see that button available for cockpit use (see screenshot above) => you will see that button offered.

Besides snacks, also any **other recurring special situations can be addressed via a DIY cockpit button, and receive different aggressiveness up to a suitable iobTH level**.

Over time you can have a big number of User action Automations, and keep them "shelved" rather invisibly (clicked in-active, top left box) in your long list of potential Automations. Even when active, they only show in your cockpit (bottom grey field of your AAPS home screen) in the time slot you assigned as potentially relevant.

In the future you might be able to set the stage for a snack and other "disturbances" also via an extended menue behind the TT button on the AAPS home screen, see section 5.3.3.1

Discussion

In case you do have a snack habit and

- can not find settings, as in section 4. defined for your meals, also suit your snacks

- can not pin a as in section 5.1.4

you minimum need a "snack announcement"

5.2.4 Temporarily exiting the FCL

The "last resort" alternative always is to **temporarily** leave the FCL mode, and handle any disturbance "the traditional way" in **hybrid closed loop**.

429   The suggested FCL cockpit user interface with an extra version of violet loop on the
430   AAPS home screen (section 5.3.1) would facilitate that, including automatic removal
431   and re-appearance of the insulin button at the bottom of the APS home screen.

432

433   In case this feature is not yet available, you must:
434 Exit the FCL mode by going to AAPS/preferences/put in your password/OpenAPS SMB/scrolldown
435 to autoISF settings and switch "Enable ISF adaptation.." OFF.

436

437 Unfortunately, there is no way yet for it to come automatically back on, after a selected time for
438 instance. So do not forget to switch your autoISF fully back on, later.

439

440   As this will often be forgotten, it may be worth doing a "User action" Automation, for a "temp.
441   FCL OFF" grey button (see section 5.2.1).
442   Caution though, there is very limited experience with this brand new feature

443

444 To recognize whether autoISF currently runs with ISF adaptation or not, you must consult the
445 profile_sens -> actual_sens indicator below the Autosens%. However, this gets also modified
446 by %profile switches or TT +/- exercise mode. So it is not as easy as it would be with the "violet
447 loop" proposal mentioned already above.
448 Ultimately, you can of course study the SMB tab to find out what is going on.

449
450

5.3 Modulating aggressiveness manually from the improved FCL-cockpit

451
452
453

454 autoISF 3.0 is an early dev variant of AAPS, and as user you are participating in an on-going
455 development. Of note, autoISF 3.0 is first launched without many of the cockpit features that are
456 presented below in this font color.

457

458   Only what is written in black is at this point of some relevance for using autoISF 3.0.
459   **No need to read** any of the green lines, unless you are interested in contributing to
460   define/design/program further improvements.
461   This is also an open invitation for you to contact us in case you could help program a
462   module for one of the suggested user interface extras.
463   For future integration into AAPS Master, an eye should be kept also on the question which
464   *other* modes (like FCL using Automations and others mentioned in section 13; and maybe
465   also HCL) might benefit from some of the extra features.

466 For the time being, multi-step work-arounds may become necessary

467 • In many cases, going into AAPS Preferences and changing settings would be needed
468 (…plus not forgetting to change these settings back, afterwards).

469 • Automations allow a DIY FCL cockpit, see section 5.2 and case studies 5.2 and 6.2

470
471 Keep in mind, though, that the **goal should be to interfere with the loop as little as possible**.
472 Under the described conditions it can run **fully automatically** without any user interaction (= after
473 the initial tuning phase, and related settings made in AAPS /preferences/SMB/autoISF. See section
474 4. and 5,1).

475
476 However, just like in the airplane cockpit: Cruising in full auto mode should involve having an eye
477 on the instruments, and on potential disturbances ahead in the environment.
478   *E.g.: storm ahead => instruct your plane to climb to another flight height.*
479   *Anology: exercise ahead => setting an exercise TT, or => pressing a button that activates a*
480   *sequence of instructions (some of them probably hinging on conditions, like actual iob) how*
481   *to manage through that exercise situation).*

482
483 So, for the occasional „disturbance" coming up, you should find an easy way to

484 • call up a pre-programmed routine for automatic management, with auto-adjusted
485 aggressiveness, or:

486 • tweak a setting or two, to temporily adjust the aggressiveness

487 • There may also arise a desire to just exit the FCL mode, and be your own captain for
488 mastering a special situation.

489 All this is facilitated within seconds right from the AAPS home screen's **cockpit features** to the
490 extent they are already incorporated, or to the extent you can build alike DIY cockpit features via
491 Automations, as described in section 4.1.3 and case studies 5.2 and 6.2):

492
493 • The button that is integrated into the **violet FCL icon** serves as emergeny off button, to
494 quickly stop FCL, or to at least to immediately stop any more SMBs (…just for a couple of
495 minutes, or for the remaining meal time: pick from the options offered with just one
496 keystroke).

497 Via the violet FCL icon on your AAPS home screen, you also can access a temp. switch-off
498 button for SMBs (see section that next follows below).

499

- The **three top fields** (%profile, exercise, TT) provide access to temp. tuning of core parameters, and/or to some pre-programmed routines.

Taken together with some **new indicator fields** about your loop state (section 5.4.3 – 5.4.4), and the **grey DIY cockpit buttons** (section 5.2.2.3) this makes the AAPS home screen your **cockpit** for Full Closed Looping.

Let us look on each of these cockpit elements in some detail:

507

508 5.3.1 Violet FCL icon and underlying buttons

509

510 Novices to FCL, or really anyone running into a very special situation, may appreciate that the new
511 closed loop icon on the AAPS home screen in pink (for FCL) has buttons to quickly shut off getting
512 more SMBs (1st row), or to enter other loop modes (second row).

513

514 It functions very much as the other ones that you know from HCL already, and in fact you
515 get offered some of the same options (for instance, to switch the (full) closed loop off for 15
516 minutes for going to take a shower)

517

518 Note that in FCL you leave all BG regulation, notably against meal spikes, to the loop. So, try not to
519 disconnect in phases when your FCL must ramp up your iob.

520 The required insulin would still be supplied *after* you reconnect. However, without the user
521 pre-bolussing, the delay would be more of an issue in FCL than it had been in HCL.

522

523 Just pressing on the FCL icon, a dialogue box comes up:
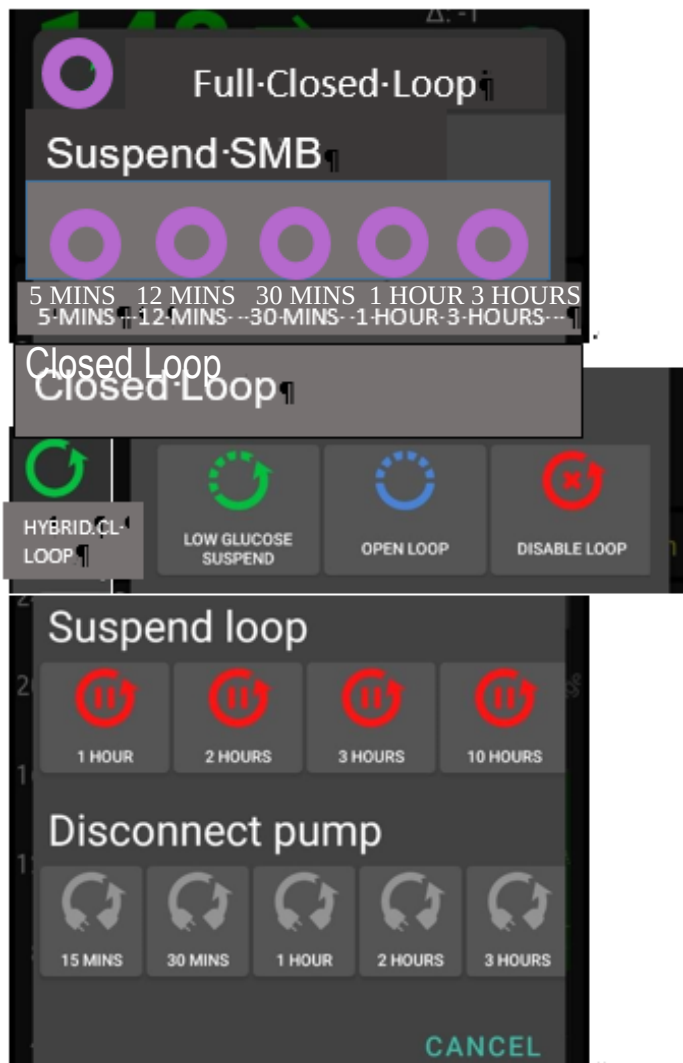
524

525 Pressing „**Suspend SMB**"provides fast and easy „emergency braking" regarding delivery of more

526 SMBs:

527 Select the one with the desired number of minutes: 5 or 12 for just blocking the potential next

528 SMB(s), and up to 3 hours to manage the entire rest of this meal with %TBR from then on.

529

530 Whenever, and why-ever, your FCL is in „no SMBs allowed" mode (e.g. <u>automatically after</u>

531 <u>surpassing an iobTH</u> , or triggered by a set odd TT), the FCL icon will turn into a dotted one.

532 Instead of remaining **duration to end time** it indicates <u>in the middle</u> „the condition", „**iob**" or „**TT**

533 Add an indication **if** suspend SMB comes from an Automation, e.g. add an **„ (A) „ underneath** the

534 #minutes, iob, or TT in the middle of the dotted violet field.

535 So, as in other (already in HCL existing) cases, those icons show in the middle the minutes left that

536 they will be running, or the condition which would have to go away for this temp. setting to stop.

537 It always auto-reverts into the FCL state and FCL icon, when time (or other condition) has elapsed.

538

539 Pressing „**HYBRID CL. LOOP**" or other buttons from the 2nd row provides fast and easy

540 „emergency **exit" into other modes**.

541   This enables beginners an easy „temp. escape" into their well-known HCL (green) at any

542   point of time. bgAccel_ISF_weight is set to zero when going FCL->HCL. HCL can run with

543   autoISF (for instance dura_ISF) uninhibited otherwise. (check implications for HCL users of

544   autoISF ??).

545 Note: These options from row 2 have no time limit. Loop will **<u>not</u>** by itself go back to FCL. You see

546 the different loop icon as a reminder to manually revert, when ready.

547

548

549 5.3.2 Buttons „Insulin", „Calculator" etc at bottom of AAPS home screen

550

551 These buttons are **not useful any longer in FCL**, and automatically disappear whenever in FCL

552 mode (also in Suspend SMB state), and re-appear when leaving FCL. This applies also when an

553 Automation or technical system failure shut off FCL.

554   Users who, maybe in the beginning phase, feel better having those buttons, can override

555   the removal (of the insulin button, or any other) by going into /preferences/overview/buttons

556   and forcing them on. They only remain on until the next re-entry into FCL mode, when auto-

557   off happens again.

558   The reason why we do this: It really is important to let the loop loop, and not interfere more

559   than absolutely needed. Any bolus the user gives will sure distort the bg curve, on which

560   autoISF, especially when aggressively tuned for FCL, builds a lot of its decisions!

5.3.3. Three top fields (%profile, exercise, TT)

Depending on the variedness of lifestyle, the desired %TIR, and the initial tuning effort put in, the user may want occasionally **to „tweek" the aggressiveness of her/his FCL**.

The top 3 fields (grey in default mode, **yellow when temp. in mode with changed aggressiveness**) serve as quick and easy entry points to make temp. switches (as users will be used to for %profile switches, or for setting an EatingSoonTT in HCL, .. which they still can do in FCL … but more:)

Expert FCL users might need this feature rarely, but probably at least to manage activity after meals: Each require opposite aggressiveness, and the switch has to come in a certain point in time that would be difficult to capture. (More see section 6.4)

575

576 5.3.3.1 TT dialoque field (Currently not available in the pictured form and function !)

577

578 The TT field (top right of AAPS home screen) is a primary daily interface, and a dialogue field
579 opens when pressing on it

Initially, the form can be entirely
empty re. TT inputs and just
show the default iobTH and
bgAccel parameters.

Two lines appear for Target and
get labeled ES, AC or HY
depending on what was pushed
at the bottom buttons. (HY =>
red frame; evtl 1 empty => grey)

TT entries can be made or
overridden.

iobTH calculates from Target
AC and other settings & shifts
away from default set in
/preferences (here 0.7) but
could be overridden here
0...200 % is allowed

bgAccel ISF_weight can be
modulated here, too. Note: It
can change again if %profile is
also changed. 0...200 % is
allowed

CANCEL allows to start fresh
(select one or two of the
square buttons, ES, AC or HY

.

OK needed to use the settings

Duration input is made in minutes. In the exceptional case that both,
ES and AC targets are defined, the duration input is for AC and
framed blue. (This is because the preceding AC mode is automatically
determined in length by the loop observing when iobTH is exceeded

580
581

582 This looks complicated but only because it allows 4 different modes of use. Each user will primarily
583 use her/his preferred one.
584 (1) Who is happy with the initially well tuned FCL and does not have huge variations in daily eating

585   and moving around, will **not use** the TT **at all**. FCL is possible without an intervention via the

586   TT button in your cockpit. Actually 4 of 8 modes (GGG …YYY permutations, list see section
587   5.4.1) are not making use of TT.

588 (2) Super easy is also, to just input **any odd-TT** (odd-numbered temporary target) that will shut out
589   any SMBs for the set duration. *That can be a good idea when having a small snack, for*
590   *instance*.

591   Super quick access to stop SMBs is possible also via the loop icon (section 5.3.1).

592   Specifically, an **EatingSoon TT** can be activated here (limited relevance see section 2.5). It is
593   time-un-critical, can be manually set, or come up via an Automation.

594   The cockpit enables you to set the iobTH differently (override) for the current meal.

595   Alternatively, iobTH can be temporarily changed in /preferences or using an Automation.
596

597   Temp. iobTH will always revert to default when the TT expires. If another TT immediately
598   follows, like in the example of the screen above, it will calculate, (then) show and use a new
599   temp. iobTH.

600 (3) The third way is to **use the input mask** (*if already ncluded in your software version* see picture
601   above) **to freely modulate the loop aggressiveness** for a declared number of minutes. Click
602   the bottom big square(s): Either HYPO, or ACTIVITY, or EATING SOON, or ACTIVITY and
603   EATING SOON (*example in the pictured screen above*). Make or override entries in the offered
604   fields. Press OK.

605 (4) The fourth way is to exclusively use one of the 4+4+2 little buttons seen in the bottom part of
606   the TT dialogue box *(if already included in your software version)*. They provide a set of
607   settings (as will immediately show in all input fields above) that the user has set up in
608   Preferences/SMB/autoISF/FullLoop (refer to section 6.3), and can freely label there. *For*
609   *instance „hiC" at high carb EatingSoon, „piz" for Pizza/fatty meals, „grd" for garden work,*
610   *„mtb" for mountain biking …*

611   **Capturing good settings for not-everyday situations in /preferences** *(if already included)*
612   **allows calling them up within 1 second**, from your cockpit on the AAPS home screen (…and
613   won't ruin the FCL experience at all , especially because in most cases it is not time-critical,
614   how long before the intended exercise the buttons are pressed).

615   Case study 6.2 demonstrates that nearly the same performance and comfort can be reached
616   via the **DIY FCL cockpit** with the grey extra buttons appearing at the bottom of the AAPS home
617   screen, based on Automations with User action (see also section 5.2.2.3).

618 is the most complicated (but also most
619 useful) case, **when exercise follows after a sizeable meal.** It is then that you need (a) aggressive
620 FCL initial performance at the meal, but, *exactly when* (!) a (for the intended sport already
621 temp.lowered) *iobTH is exceeded*, you need (b) to have SMBs automatically switched off and go
622 into the „milder" mode, as defined for the exercise (with *high* instead of the immediately prior
623 *low*TT, that automatically significantly reduces iobTH again, and insulin sensitivity(resistance)
624 settings too).
625
626 Pressing exercise related buttons will automatically also light the **exercise button** on the main
627 screen yellow.
628
629 To summarize, the TT dialogue field offers easy but powerful ad-hoc modulation of loop
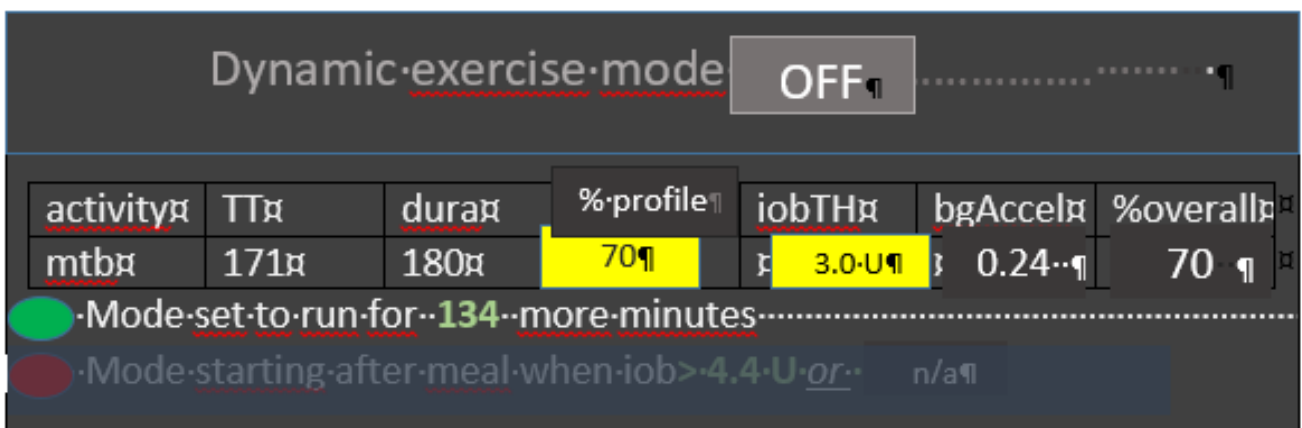630 aggressiveness for FCL (if already included).
631
632
633 5.3.3.2 Exercise button (see more in section 6.)
634
635 The exercise button automatically lights yellow when exercise related TTs are activated in the TT
636 dialogue box.
637 4 of 8 principal FCL modes (section 5.4.1) are making use of the exercise button.
638
639 If pressing on the exercise button, a dialogue box appears *(if extended design for FCL cockpit is*
640 *already launched)* with info on exercise setting first (and opportunity to override), plus below the
641 activity monitor (experimental for auto-tracking of lighter movement during the day, and effects on
642 sensitivity that may have. *See* section 4.5).
643
644 So, first the exercise settings (as set under TT) are there to read. Example :

activity¤	TT¤	dura¤	%·profile¶	iobTH¤	bgAccel¤	%overall¤
mtb¤	171¤	180¤	70¶	3.0·U¶	0.24··¶	70 ¶

🟢·Mode·set·to·run·for··**134**··more·minutes·······

🔴·Mode·starting·after·meal·when·iob>·4.4·U·*or*·· n/a¶

645
646

647 The exercise (here mtb) is selected in the dialogue box of the neigboring TT field, and there auto-
648 filled with settings made in the set-up and tuning stage by the user under preferences (see
649 above,….). They are reported also under the exercise button here, and TT, duration, and % sens
650 (which also shows active on the %profile field on the left side of the exercise button) can be temp.
651 changed there. iobTH, bgAccel_ISF and overall resulting sensitivity ratio is given in the other fields.
652 The **middle field** of the table, **„% profile"** either picks up the % set under the %profile button, or
653 an input can be made here, in the exercise button domain, which will:

654   • turn the neighboring %profile button on yellow and show that inputted % on it, too

655   • be multiplied with the result from the exercise mode settings per se, and change the %
656   overall, accordingly.

657 So, if this middle field of above table (dialogue box of sports button) contains a figure other than
658 100, input field becomes yellow,and you are operating with a combination of traditional PLUS new
659 exercise mode (with all three top buttons of your FCL cockpit yellow). This maximally will soften
660 aggressiveness, for which you get an idea by the last calculated figure.

661

662 The mode is either running already (for another number of minutes, as probably also shown in the
663 yellow TT field anyways). Or it is scheduled to run, after insulination for a started meal reaches
664 iobTH (as in table). Or, no exercise is scheduled (both points red, no entries.

665

666 The lower part of the exercise dialogue box (not pictured above, but see in <u>section 6.5</u>) is
667 dedicated to the Activity Monitor

668

669 5.3.3.3 Profile button

670 The profile button can still be used to set a different profile, or profile%, for instance to adjust for
671 days with sickness (as you are used to from hybrid closed looping). 4 of 8 modes are not making
672 use of the profile button.

673

674 Any inputs made here will be used to modify profile_ISF on which all further changes are made on
675 (multiplied with).

676

677 The profile field remains grey if standard profile is applied.
678 It turns yellow, displaying a %figure relating to any altered loop overall aggressiveness:

679   • When no inputs (changes from 100% profile) are made here, but inputs in the TT field,
680   e.g. for exercise, automatically lead to different insulin sensitivity ratio ~~that ratio is shown~~
681   ~~here~~

682   • when% is changed by input in the profile button itself, it will be multiplied with with
683   profile_ISF and be used in place of profile_ISF *by the algorithm*.

684　However, for exercise (sports) you no longer must make an entry here, because

685　reasonable %reductions should be automatically provided, driven by your set TT (and half-basal

686　exercise target), see .

687

688　5.4 Recognizing your loop state in the AAPS home screen

689

690　5.4.1 Color scheme of top cockpit buttons tells kind of closed loop that is running

691

692　3 Buttons (%profile; exercise; TT) each in 2 states (yellow Y, or grey G) make 2 exp 3 =

693　**eight principal FCL modes** possible:

694

695　GYY = dynamic exercise mode

696　YGY = not-dynamic „traditional" exercise mode (if <100%) or hypo mode (if >100%)

697　GYG = basic closed loop with Activity Monitor running

698　GGG = basic closed loop (FCL or HCL) without any altered sensitivities etc

699　YGG = basic closed loop but with a „long wave" sensitivity shift (e.g. sickness)

700　GGY =temp. target like e.g. EatingSDoonTT is set; or Hypo mode

701　YYG = closed loop with „long wave" sensitivity adjustement and Activity Monitor running

702　YYY = dynamic exercise mode in time with additional „long-waved" sensitivity shift

703

704　5.4.2　Information printed on the top buttons

705

706　The yellow TT field shows the currently valid TT (and further duration):

707　(profile) stands for the abbreviation you labeled your selected running profile

708

709　In the special case of settings for meal preceding sports, the field will look slightly differently:

710　…and …

711　… when iobTH is first time exceeded, this automatically switches to:

712

713

714 Likewise, if on the AAPS main screen just an **EatingSoonTT** is set (e.g.72), this is entered with the

715 desired duration. Afterwards, it automatically reverts to profile target and the display turns grey

716 again there with e.g. 90 on it (and no time limit).

717 Without sports context, the middle field remains grey.

718

719

720 Independently from setting a TT, the user can choose to set a **%profile in the left top field**, for an

721 independent number of minutes, e.g. 70% in this screen example: Also, or additionally, this will

722 influence the resulting ISF and sensitivity%

723

724

725

726 The % might change and turn yellow also in context of making TT inputs in the related dialogue

727 box (see chapter TT dialogue field, above). Still, the % (or the length of time the profile switch shall

728 be active) can be independently overriden in the top left field, if so desired.

729

730 If an **Automation** sets a %profile, and/or a TT *(e.g. automatic detection of meal start at condition*

731 *e.g. when delta >10*) , this would automatically show in respective field(s) turning yellow and

732 showing the temp. setting. To show the set parameter comes from an Automation, „ **(A)** „ is added

733 in the end of button text.

734   Note that an Automation is usually/ always (?) only permitted to temp. change <u>default profile</u>

735   settings, not other pre-existing temp. settings. This is for a good reason : Why should a

736   sometimes in the past thought-out Automation supersede your - just for the occasion

737   specified – temp.settings that you consciously activated for the day?

738   Advice: Try to stay away from Automations that also aim at temp. modifying

739   aggressiveness. For the reason just given in above note, they often will not kick in anyways.

740   Generally, it also is no good idea to double up sub-algorithms for tweaking loop behaviours.

741

742 Try to **keep things as simple and clear as possible.**

743

That said, a limited number of Automations can be of help in distinct scenarios (that differ in purpose and in applicable time of day).

A good one could be for night time, when your odd profile TT has SMBs shut off, but your experience after pizza nights tells you that, under certain condition patterns (bg, iob), an SMB or two should be „allowed in" (see example given in section 5.1.2).

Another good example, if you go usually FCL without any use of the TT button (which would be a meal announcement of sorts), is to define an Automation that, after detecting a meal start, automatically sets a low TT to get maximally aggressive first SMBs (as is the author's preferred way, mentioned already in section 2.5).

5.4.3 FCL related indicator fields in the AAPS home screen

In extra data fields of the AAPS main screen you can always see (not change) the key „aggressiveness" parameters your loop currently operates operates with (see also home screen example below):

- how profile sensitivity (**ISF**) changes by the %profile input, by autoISF, and/or a set exerciseTT.

- next to current available iob number is an indication of your **valid iobTH** (the iob above which no more SMBs will be given)

- The AAPS home screen additionally shows, above the deltas, the current **acceleration**

  Having a look at that can be valueable. For instance, when glucose is relatively low and still falling, a positive (and getting more positive) acceleration indicates that bg will swing back up, rather than crash low. This will give info about necessary snack size, and hence help avoid both, unnecessary calories, and going on a bg rioller coaster.

768
769
770 5.4.4 Overall home screen:
771

Overall home screen:

<- Cockpit: yellow fields=>temp. modulated sens.

<- here additionally: acceleration-factor

< - Violet < - > green circle for FCL < - > HCL dotted if SMB off
in the middle: minutes counting down if temp.set;
below: (A) if coming from an Automation that is running

< - iobTH

<- % reduced insulin supply... because of resulting...

< - higher (weaker) ISF

<- buttons „bolus" „carbs" etc. eliminated
(auto- re-appearing when violet –> green loop)

772   –
773
774