

## Gunners

A short analysis about AI gunner behavior about target tracking and shooting.

<http://www.histoire-simulation.org> ht

Inside FB, 6 phases are defined:

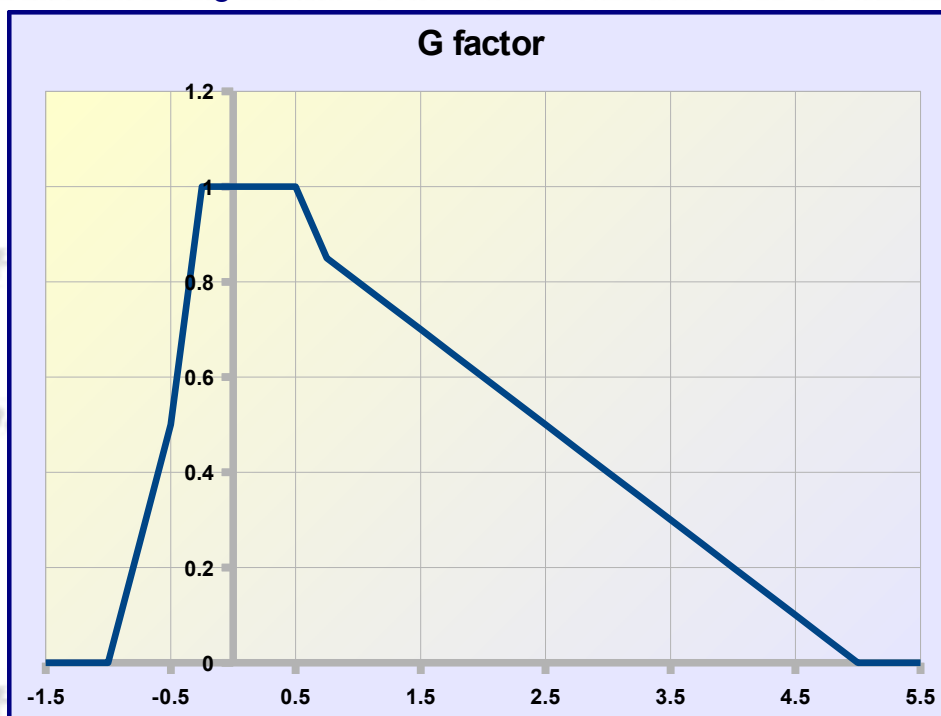
- ◆ sleep phase,
- ◆ tracking phase,
- ◆ firing and tracking phase,
- ◆ stop firing phase,
- ◆ panic phase,
- ◆ stop phase.

Names are explicit and avoid any developments. FB processes these different phases, but also transition from one phase to another phase. For this last point, order shows here above is not significant.

Several parameters are involved in these phases with, in particular, distance between target and gunner, relative speed between target and gunner, ... There is an additional parameter and, in fact, it will be used to tune gunner behavior.

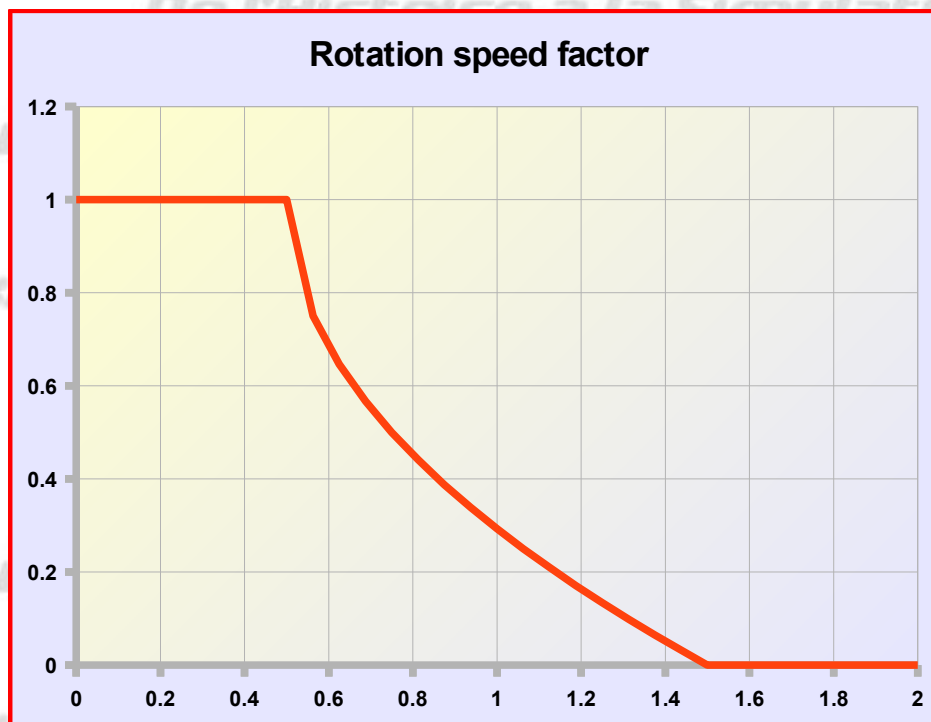
These last parameter is obtained by multiplication from three elementary factors:

- ◆ first factor is the gunner skill level. At this time, it is equal to AI skill level defined for each aircraft in the mission file. This level can take for discrete values [0, 1, 2, 3] corresponding to [rookie, normal, veteran, ace].
  - ◆ Second factor is link to aircraft AI load factor and can take any value between 0 and 1.
- Shape is the following:



Easy to see that nothing appears between -0.25g and + 0.5g. Nevertheless, when a bomber box is on fire, evolutions are limited and induced load factor is poor. In conclusion, this factor is probably close to 1.

- ◆ third factor is link to the speed rotation of the machine gun or turret. This speed rotation is composed by the aircraft AI speed rotation in flight (roll, yaw and pitch) and by the speed rotation of machine gun or turret with regard to AI aircraft. Speed rotation is given in radian per second and the shape is the following:



Decrease start at 0.5 radian per second which is about 29 °/s. This value is high and close to rotation rate of a fighter, but far to a muliengine bomber rotation rate. Here again, consequence is, when attacking bombers, this factor is close to 1.

Multiplication of these three elementary factors gives a number between 0 and AI skill level with a high probability, when attacking bombers, to be close to AI skill level.

At least, two solution appears in order to tune AI gunner without altering AI aircraft level:

- ◆ addition of new skill levels dedicated to gunners. Doing that is possible, but difficult with regard to the FB actual coding structure. Moreover, gunner skill level are used in several line and this solution does not prevent border effect...
- ◆ add a new coefficient and multiplied the parameter by it. In this case, it will be the result of multiplication by four elementary factors and not 3 as the "non modded" version.

Second solution will be chosen. These coefficient will have a value between 0 and 1 and default value will be 1 (in this case, no change with non modded version). In addition to this coefficient, another parameter will be added to take in account a kind of deviation around the coefficient. Default value will be 0 (no deviation). From these two numbers, a random value for the final new coefficient will be defined, but in any case will be between 0 and 1. Some examples:

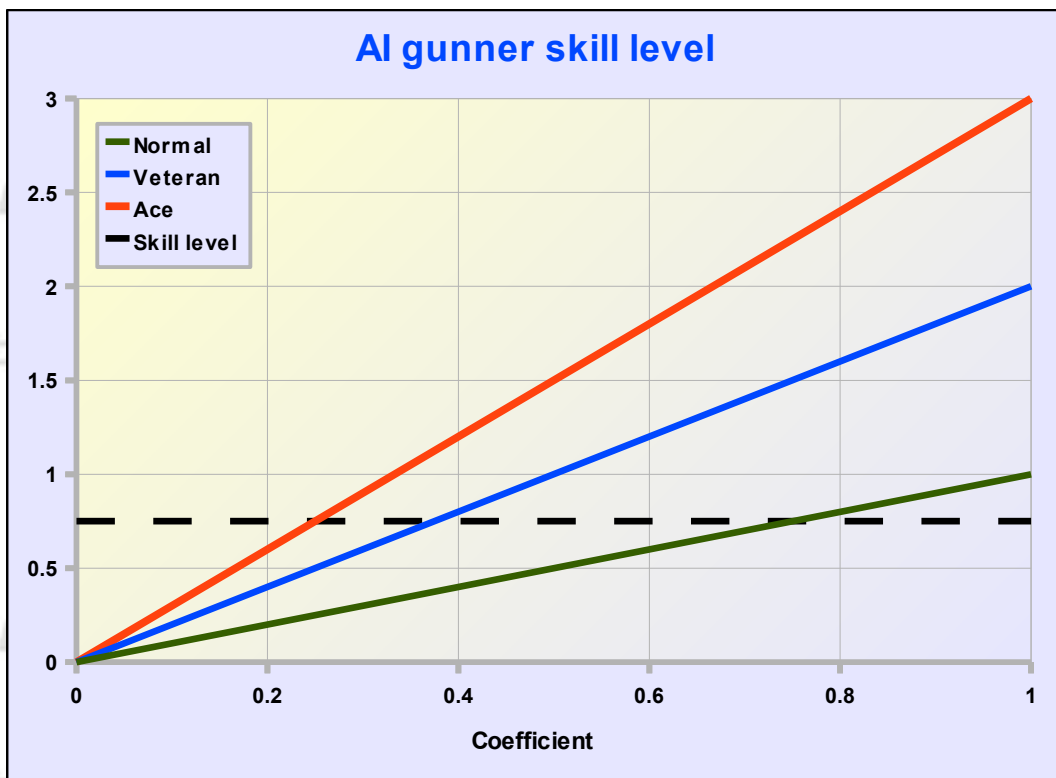
- ◆ if you set 0.8 and 0.15 for these two numbers, the final coefficient will be a random value between 0.65 and 0.95.
- ◆ if you set 0.9 and 0.3, the final coefficient will be a random value between 0.6 and 1.
- ◆ If you set nothing, final coefficient will be 1.

These two additional parameters will be defined inside the mission file for each AI aircraft. With the combination of to, you will have the insurance that:

- ◆ each AI aircraft will have a different value
- ◆ each gunner, inside a same AI aircraft will have a different value.

Computation of the new coefficient and multiplication with AI gunner level will be done during mission loading with no impact on processor load during mission.

In conclusion, a small example to describe more precisely what had been explained here above. Imagine you have different AI aircraft with gunners and you want that gunner have the same average level (ie equal to 0.75). Consider this scheme:



According to this scheme, you have to choice different coefficients function of AI level:

Coefficient	AI aircraft level		
	Normal	Veteran	Ace
	0.75	0.375	0.25