Launch Acceptable Region Calculation Procedure using R-Project and MARS Algorithm

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In this work, Launch Acceptable Region (LAR) for smart munitions will be defined and an approach with Multivariate Adaptive Regression Splines (MARS) will be given[4]. LAR can be defined as a region where the target will be successfully reached if the weapon is released within this zone. There is a flexibility of choosing different release points within a zone for guided munitions by reshaping their trajectories during flight, but this is not the case for the unguided weapons because of their ballistic trajectories. Similar to the balistic algorithms that computes release points for unguided weapons, Launch Acceptable Reagion algorithm are being developed for guided weapons. Using the non parametric regression methods is one of the approachs for calculation of LAR using the data sets obtained from simulation results. In this work, the methodologies developed for calculation of LAR using *R-Project* will be presented. In General, there are two types of LARs. First one is the In Zone LAR in which the munition reaches the target by following the predefined waypoints and successfully performs the desired impact angle and attack azimuth. In Range LAR represents the zone in which the munition directly goes to target without following the waypoints and does not take account of the desired impact conditions (See Figure 1). [1] [2], [3].
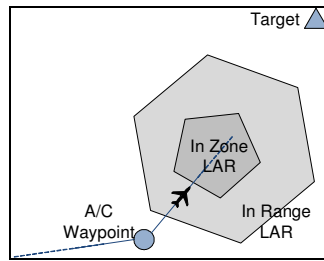

Figure 1 Illustration of LAR

A trajectory generator (either in 3DOF or 6 DOF) is used to generate the operational data for the munition. This truth data is used to model the LAR using **mdaPkg** and **earthPkg.** A sample R-Project code is given to represent the procedure of LAR calculation [5].

Table 1 R-Project code

```
#load mda and earth packages
library(mda)
library(earth)
### Read Truth Data ###
data=NULL
truthData<-read.table("TruthData.Rdata",header=TRUE)
### Generate a mathematical fit using earth package###
## Use the first 5 parameters of the thruthdata and model the 6th parameter###
model<-earth(truthData[,1:5],truthData[,6])
```

References

1. Clarck, D., Faust, A., and Jones, A., (2001) ``Common Launch Acceptability Region Task Group'', SAE Technical Papers 2001-01-2953, 2001
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5. R Project, Earth Package Reference Manual, http://cran.r-project.org/web/packages/earth/index.html