

Information Fusion using Bayesian Networks

Information fusion involves combining elements of classification, filtering, measures of effectiveness and temporal dynamics into one model. This can look daunting but is actually fairly straightforward to model in AgenaRisk. Here we show a small example illustrating how this can be achieved.

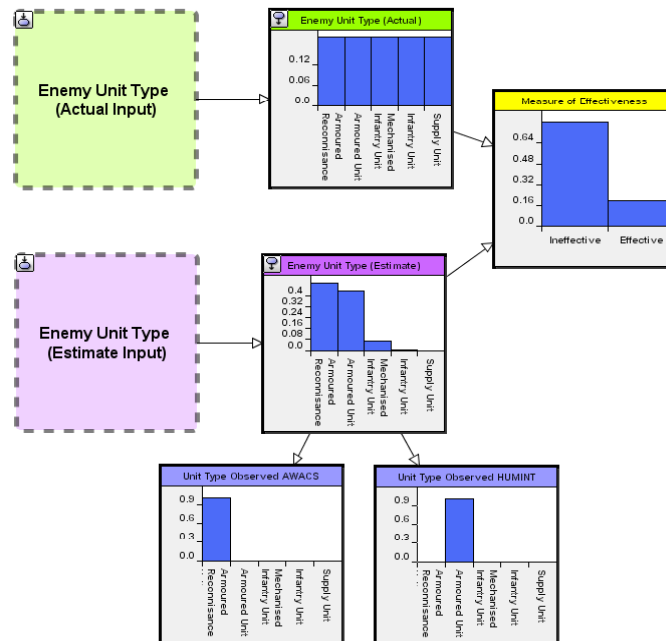


Figure A

The objective of the model, shown above, is to identify the type of enemy unit for the purpose of enemy target identification using information gained from one or more sensors. The set of possible types of enemy unit are: {Armoured Reconnaissance, Armoured, Mechanised Infantry, Infantry, Supply}. Two sensors are available: AWACS and HUMINT. AWACS is an Airborne Warning And Control System and HUMINT is Human Intelligence. Each of the sensors has different probabilities of detecting different types of enemy unit. HUMINT is better at differentiating soft skin targets, {Infantry, Supply}, from hard targets, {Armoured Reconnaissance, Armoured, Mechanised Infantry}. This is reflected in the relevant NPTs embedded in the model.

As well as estimate the type of unit from the sensors, the model also produces a MoE to calculate how effective the model actually is at identification of a known target. Hence we add nodes representing the actual unit type and the MoE score. If the actual target type and the estimated target type match then the identification process is effective.

The model contains an “Information Fusion Basic Object” which contains an “interface” for passing information learned in one time period to be used in the next. The model can then be repeatedly imported to create a linked series of objects representing multiple time periods where the information is passed from one time period to the next. This is shown in Figure B.

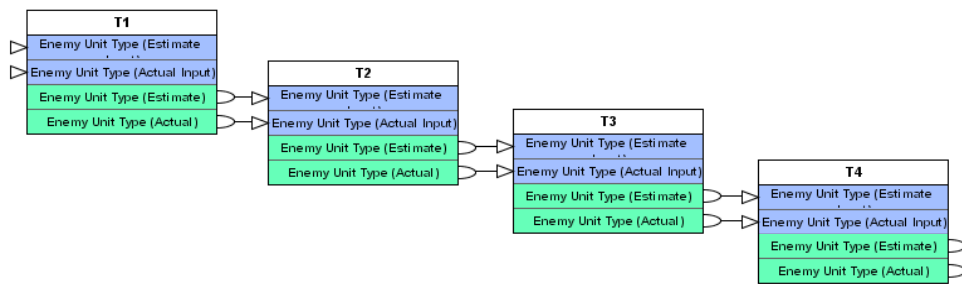


Figure B

In the model we have entered data on time periods 1-4, in the form of sensor readings AR = Armoured reconnaissance and A = Armour, comparing HUMINT and AWACS target identification gathered during an exercise involving a known target type – “armour”. You can see that the MoE varies over time even in the presence of noisy sensors and missing data from HUMINT in time period 3 (T3):

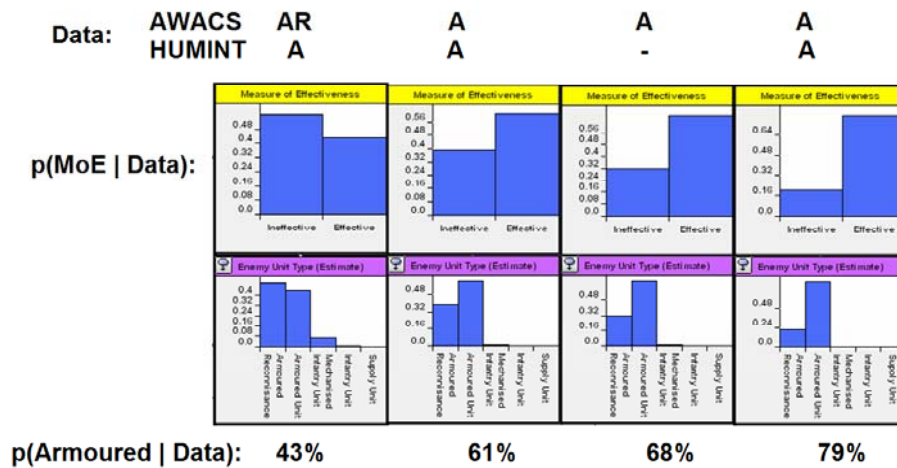


Figure C

To try out this model download a trial version of AgenaRisk from www.AgenaRisk.com and access the “Information Fusion.ast” example in the “AgenaRisk Examples\Advanced\Information Fusion” folder.