audition, motor, speech, and cognition. The conflict matrix instantiates Multiple Resource Theory by, for example, ensuring that any two visual tasks receive a higher conflict value (e.g., .7-.9) than any visual + auditory task pair (.2-.4).

Given these considerations, a conflict value must be assigned for every combination of pairs of channels. This may be done for a newly defined channel via the Edit Channel window presented in figure 4b above. Alternatively, all previously defined pairwise conflict values may be reviewed and edited by selecting the "All Conflicts" button on either the Channel screen (Figure 4a) or the Edit Channel screen (Figure 4b). This results in accessing the window presented in Figure 5.

## 4. Solution Description

### 4.1 *Calculating Conflict Levels*

Given the conceptual crew station, mission segments, a task/activity matrix, and a conflict matrix, the degree of conflict for each operator can be calculated at any point in the segment as the sum of all pairwise conflict values incurred by the resources required for all concurrent tasks at that time. If attentional demand values are used, then pairwise conflict values are weighted by attentional demand values. These operations are performed automatically over the timeline provided when W/Index is asked to calculate workload values for the scenario. While this equation is simpler than that used in many workload-based assessment or prediction approaches, it provides as much predictive power as any other method while providing the most useful information regarding display and control type and location (cf. [5]).

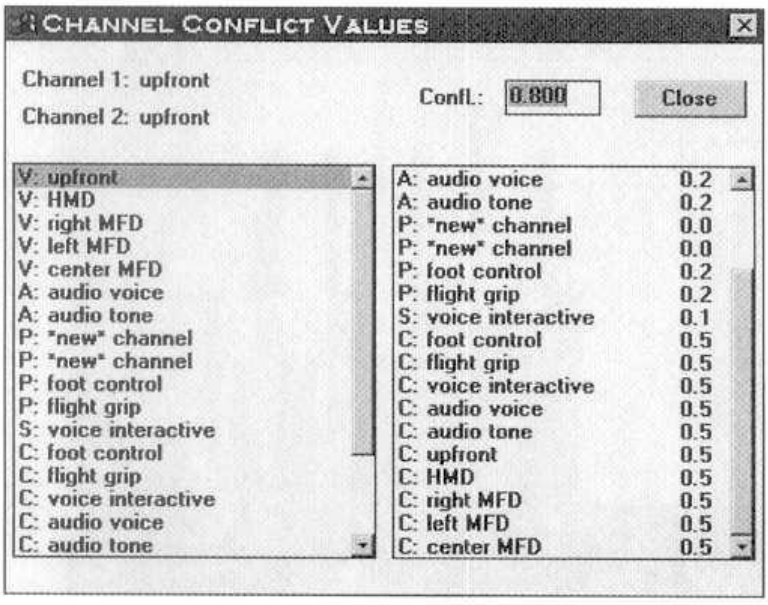


**Figure 5. Pairwise Channel Conflict review and editing window.**

### 4.2 *Using Conflict Levels in Design—An Automation Example*

W/Index provides a conflict profile for the operator throughout the timeline. The true power of W/Index, however, is in its ability to quickly assess how a change in interface or task assignments might affect the operator's workload profile. This is, therefore, a simple, low cost method of redesigning an entire crew station and ascertaining the effects on human performance. By using the baseline conflict profile for a segment, we can perform multiple permutation analyses corresponding to speculative modifications to the crew station, task allocation, or operational procedures. A conflict profile using the revised model is then compared to the baseline model and the impact of the changes analyzed.

Figure 6 presents one illustration of this approach from our scout/attack helicopter study. In this example, we envisioned a decision aid to help the pilot monitor the presence and locations of enemies and team members—that is, a piece of automation which would monitor sensor data to compare the location of team members and enemies and alert the human crewmembers of evolving threat situations. Note that this aid is far from being developed, and that one motivation for doing this permutation analysis was to decide whether such an aid would be valuable.

In the baseline model, these tasks required monitoring the Center display and using spatial cognition with reasonably high levels of attention. For the permutation modeled in Figure 6, we envisioned a smart, automated aid which would track enemy and friendly locations and movements, and alert the pilot when an unanticipated threat was evolving. Since this aid essentially enables managing these tasks by exception, we modeled no pilot resources expended for these tasks during most of the segment. Alternative (and perhaps more realistic) approaches might include an aid that provides movement projections and threat identification on a display—thereby greatly reducing the cognitive demands of these tasks while retaining most of the visual demands.

The output data from two separate W/Index runs are graphed (using Microsoft Excel's Chart Wizard) in Figure 6. These results show that the hypothetical aid produces large drops in conflict over the baseline crew station