

PROFESSOR JOSEPH A. GIACOMIN
DIRECTOR OF HUMAN CENTRED DESIGN INSTITUTE
SCHOOL OF ENGINEERING AND DESIGN
BRUNEL UNIVERSITY
UXBRIDGE, MIDDLESEX, UB8 3PH, UK
TEL: 01895 265 340 FAX: 01895 269 763
E-MAIL: JOSEPH.GIACOMIN@BRUNEL.AC.UK
WEB: WWW.PERCEPTIONENHANCEMENT.COM



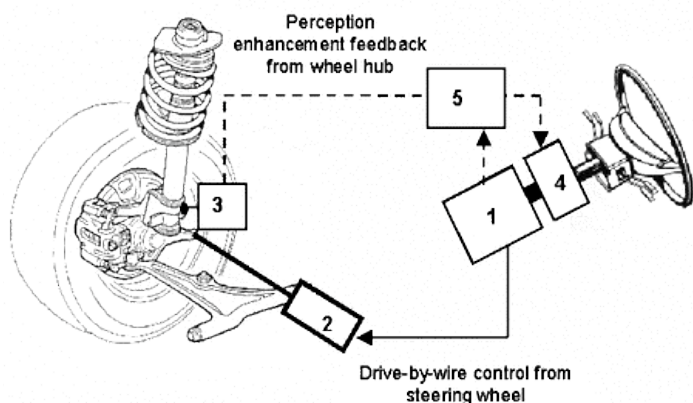
2/2/2009

PERCEPTION ENHANCEMENT SYSTEMS : TECHNOLOGIES FOR MAKING THE WORLD MORE INTUITIVE.

IN ROAD VEHICLES NEW INTERFACES ARE BEING DEVELOPED WHICH INTEGRATE THE FUNCTIONS OF HUMANS WITH THOSE OF THE MACHINE, BLURRING THE TRADITIONAL DISTINCTIONS BETWEEN THE TWO. IN THIS COMPLEX NEW ENVIRONMENT THE CONCEPT OF PERCEPTION ENHANCEMENT EMERGES FROM THE OBSERVATION THAT NOT ALL ENVIRONMENTAL STIMULI ARE INFORMATIVE, ONLY CERTAIN COGNITIVELY-RELEVANT FEATURES FROM THE ENVIRONMENT HAVE MEANING FOR HUMANS. THE GOAL IS THEREFORE TO DEVELOP PERCEPTION ENHANCING SYSTEMS WHICH SELECTIVELY AMPLIFY THE KEY ENVIRONMENTAL STIMULI SUCH THAT HUMANS CAN BETTER INTERACT WITH THEIR MACHINES AND AUTOMATED ASSISTANTS.

THE CONCEPT OF PERCEPTION ENHANCEMENT IS NOT A NEW ONE, AT LEAST NOT IN THE AREA OF VISION AND OPTICS. OPTICAL LENSES FOR ENLARGING OR REDUCING WERE USED IN GREEK AND ROMAN TIMES, AND THERE EXIST AMONG THE WRITINGS OF SENECA SEVERAL EXAMPLES OF THE USE OF SUCH DEVICES TO ASSIST READING. A MORE RECENT DEVELOPMENT, HOWEVER, IS THE ABILITY OF NEW TECHNOLOGY TO PROVIDE SOPHISTICATED SYSTEMS FOR MODIFYING ENVIRONMENTAL STIMULI SO AS TO MAKE THEM MORE INTUITIVE. NEVER BEFORE HAS TECHNOLOGY PROVIDED SUCH A GREAT VARIETY OF WAYS FOR ENHANCING THE PROPERTIES OF THE STIMULI WHICH LIE AT THE HEART OF HUMAN PERCEPTION.

IN THE CASE OF ROAD VEHICLES THE TERM PERCEPTION ENHANCEMENT SYSTEM CAN BE USED TO DESCRIBE ANY DEVICE WHICH OPTIMISES THE FEEDBACK TO THE DRIVER OF INFORMATION ABOUT VEHICLE INTERACTION WITH THE ENVIRONMENT. SUCH SYSTEMS TREAT STIMULI FROM AN INFORMATION THEORETIC POINT OF VIEW, AND OPTIMISE THE PERSON-MACHINE INTERFACE SO AS TO MAKE THE VEHICLE FEEL MORE LIKE AN EXTENSION OF THE DRIVER'S BODY. THE OBJECTIVE IS TO IMPROVE THOSE CHARACTERISTICS OF THE STIMULI WHICH TRIGGER USEFUL COGNITIVE CUES, WHILE SIMULTANEOUSLY REDUCING THOSE CHARACTERISTICS WHICH ARE NORMALLY ASSOCIATED WITH BACKGROUND NOISE. KEY TO THE SUCCESSFUL DESIGN OF PERCEPTION ENHANCING SYSTEMS IS THUS A WORKING KNOWLEDGE OF THE RELATIONSHIPS BETWEEN THE STIMULI WHICH PEOPLE PERCEIVE ON THE ONE HAND AND THEIR ENVIRONMENTAL SOURCES ON THE OTHER.

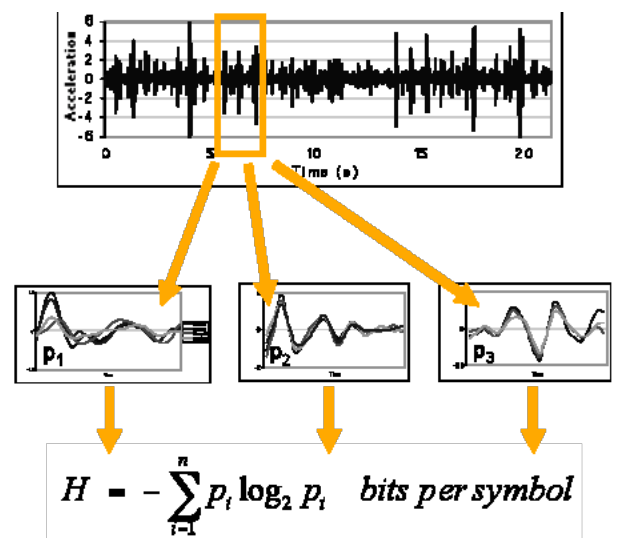


TWO GENERAL CLASSES OF PERCEPTION ENHANCEMENT SYSTEM ARE BEING INVESTIGATED BY THE MEMBERS OF THE *PERCEPTION ENHANCEMENT SYSTEMS (PES)* RESEARCH GROUP. THE FIRST INVOLVES SINGLE MODALITY SYSTEMS IN WHICH VIBRATIONAL OR ACOUSTICAL STIMULI ARE SELECTIVELY MANIPULATED SO AS HIGHLIGHT THE DOMINANT COGNITIVE CUES, RENDERING THE STIMULI EASIER TO UNDERSTAND AND MORE INTUITIVE. THIS CLASS OF SYSTEM OPERATES WITHIN A SINGLE PERCEPTUAL MODALITY AND IS BASED ON THE USE OF

ANALYTICAL TRANSFORMATIONS WHICH MODIFY THE STATISTICAL PROPERTIES OF A STIMULUS FROM THE ORIGINAL FORM WHICH IS PRODUCED BY THE ROAD VEHICLE TO AN ENHANCED FORM WHICH SHOULD BE PRESENTED TO THE HUMAN. THE OVERALL AIM OF THE APPROACH IS NOT TO CHANGE THE STIMULUS TO THE POINT OF DENATURING IT, BUT, RATHER, TO IMPROVE ITS STATISTICAL PROPERTIES AS MUCH AS IS PRACTICALLY POSSIBLE IN ORDER TO RENDER IT MORE EASY TO UNDERSTAND AND INTUITIVE. IN THIS APPROACH THE ANALYTICAL TRANSFORMATIONS WHICH ARE APPLIED TO THE STIMULI ARE USUALLY BORROWED FROM THE FIELD OF MUSIC MASTERING OR FROM THE FIELD OF INFORMATION THEORY.

PERCEPTION ENHANCING TRANSFORMATIONS BORROWED FROM THE FIELD OF MUSIC MASTERING INCLUDE THE USE OF STIMULUS COMPRESSORS OR EXPANDERS, WHICH MODIFY THE PEAK VALUES OF THE VIBRATION OR THE SOUND SO AS TO EITHER DRIVE LARGE EVENTS DOWN INTO THE MAIN BODY OF THE STIMULUS OR SO AS TO EXTRACT SPECIFIC LARGE EVENTS OUT FROM THE MAIN BODY OF THE STIMULUS. THE GENERAL CONCEPT IS TO ADJUST THE RELATIONSHIP BETWEEN THE LARGE EVENTS AND THE SMALL EVENTS, BALANCING THE ONE AGAINST THE OTHER, IN AN OPTIMAL MANNER WHICH MAKES THE STIMULUS EASIER TO UNDERSTAND AND MORE INTUITIVE.

PERCEPTION ENHANCEMENT TRANSFORMATIONS BORROWED INSTEAD FROM THE FIELD OF INFORMATION THEORY ARE BASED ON THE USE OF INFORMATION CARRYING EVENTS. IN THE CASE OF ROAD VEHICLE VIBRATION OR SOUND, INFORMATION CARRYING TRANSIENT EVENTS HAVE BEEN IDENTIFIED WHICH ARE CALLED "BUMPS". THESE SEMIOTIC SYMBOLS ACT AS THE BASIC UNIT OF INFORMATION WHICH HUMANS USE WHEN INTERPRETING THE STIMULUS. BY IDENTIFYING THE LIBRARY OF "BUMPS" WHICH ARE EMITTED BY A ROAD VEHICLE UNDER SPECIFIC OPERATING CONDITIONS, IT IS THEN POSSIBLE TO TAILOR THE NUMBER AND SIZE OF THE "BUMPS" SO AS TO MODIFY A STIMULUS FROM ITS ORIGINAL FORM TO AN ENHANCED FORM. ADJUSTING THE NUMBER AND SIZE OF THE "BUMPS" IN REAL TIME MAKES THE STIMULUS EASIER TO UNDERSTAND AND MORE INTUITIVE.



THE SECOND GENERAL CLASS OF PERCEPTION ENHANCEMENT SYSTEM BEING INVESTIGATED BY THE MEMBERS OF THE RESEARCH GROUP IS THAT OF MODALITY TRANSFORMING SYSTEMS. IN THIS APPROACH INFORMATION FROM ONE STIMULUS MODALITY IS TRANSFORMED INTO ANOTHER MODALITY SO AS TO FACILITATE DETECTION AND INTERPRETATION. THE GENERAL CONCEPT IS TO USE THE FREEDOM OFFERED BY MODERN TECHNOLOGIES SO AS TO TRANSFORM SENSORY INFORMATION FROM A CHANNEL CHARACTERISED BY RELATIVELY LIMITED PERCEPTUAL CHARACTERISTICS TO ONE WHICH IS CHARACTERISED BY RELATIVELY SOPHISTICATED PERCEPTUAL CHARACTERISTICS. SUCH PERCEPTION ENHANCEMENT SYSTEMS CAN BE THOUGH OF AS SYNAESTHETIC TRANSFORMERS. THE APPROACH OF TRANSFORMING A STIMULUS FROM ONE MODALITY TO ANOTHER CAN MAKE A STIMULUS EASIER TO UNDERSTAND AND MORE INTUITIVE THROUGH A VARIETY OF EFFECTS INCLUDING GREATER SPATIAL EXTENT, GREATER SPATIAL RESOLUTION, IMPROVED FREQUENCY RESPONSE, LOWERED PERCEPTUAL

THRESHOLD, NOVELTY OR IMPROVED ASSOCIATION WITH SITUATION-RELEVANT COGNITIVE CONSTRUCTS.



PERCEPTION ENHANCING SYSTEMS OF THIS SECOND CLASS ARE TYPIFIED BY THE POPULAR MODERN TECHNOLOGY OF THERMAL IMAGING CAMERAS. THE PERCEPTION ENHANCEMENT SYSTEMS (PES) RESEARCH GROUP HAS BEEN INVESTIGATING THE ABILITY OF THERMAL

IMAGING TO ENHANCE THE IMMEDIACY AND INTUITIVENESS OF THE HUMAN UNDERSTANDING OF TEMPERATURE AND OF TEMPERATURE ASSOCIATED PROPERTIES. RESEARCH QUESTIONS INCLUDE THE ACHIEVABLE REDUCTION IN DETECTION TIMES WHEN THERMAL INFORMATION IS MADE VISIBLE, THE ACHIEVABLE REDUCTION IN TRAINING TIMES WHEN THERMAL INFORMATION IS MADE VISIBLE AND THE POTENTIAL OF THERMAL VISIBILITY TO INCREASE AWARENESS AND TO AFFECT LIFESTYLE CHANGES IN RELATION TO ISSUES SUCH AS GLOBAL WARMING.