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HUMAN-MACHINE INTERFACE IN MOBILE TELEOPERATORS*

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**THE HUMAN-MACHINE INTERFACE
IN MOBILE TELEOPERATORS**

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THE HUMAN OPERATOR IS AN IMPORTANT ELEMENT IN MOBILE TELEOPERATIONS



ORNL 5013-83

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THERE ARE SEVERAL REASONS FOR THE IMPORTANCE OF THE HUMAN OPERATOR

- ◆ **VARIABLE ENVIRONMENT**
- ◆ **NON-REPETITIVE TASKS**
- ◆ **REQUIREMENTS FOR MULTIPLE TOOLS**
- ◆ **FAULT DIAGNOSES REQUIRED**
- ◆ **STRATEGIC DECISIONS REQUIRED**

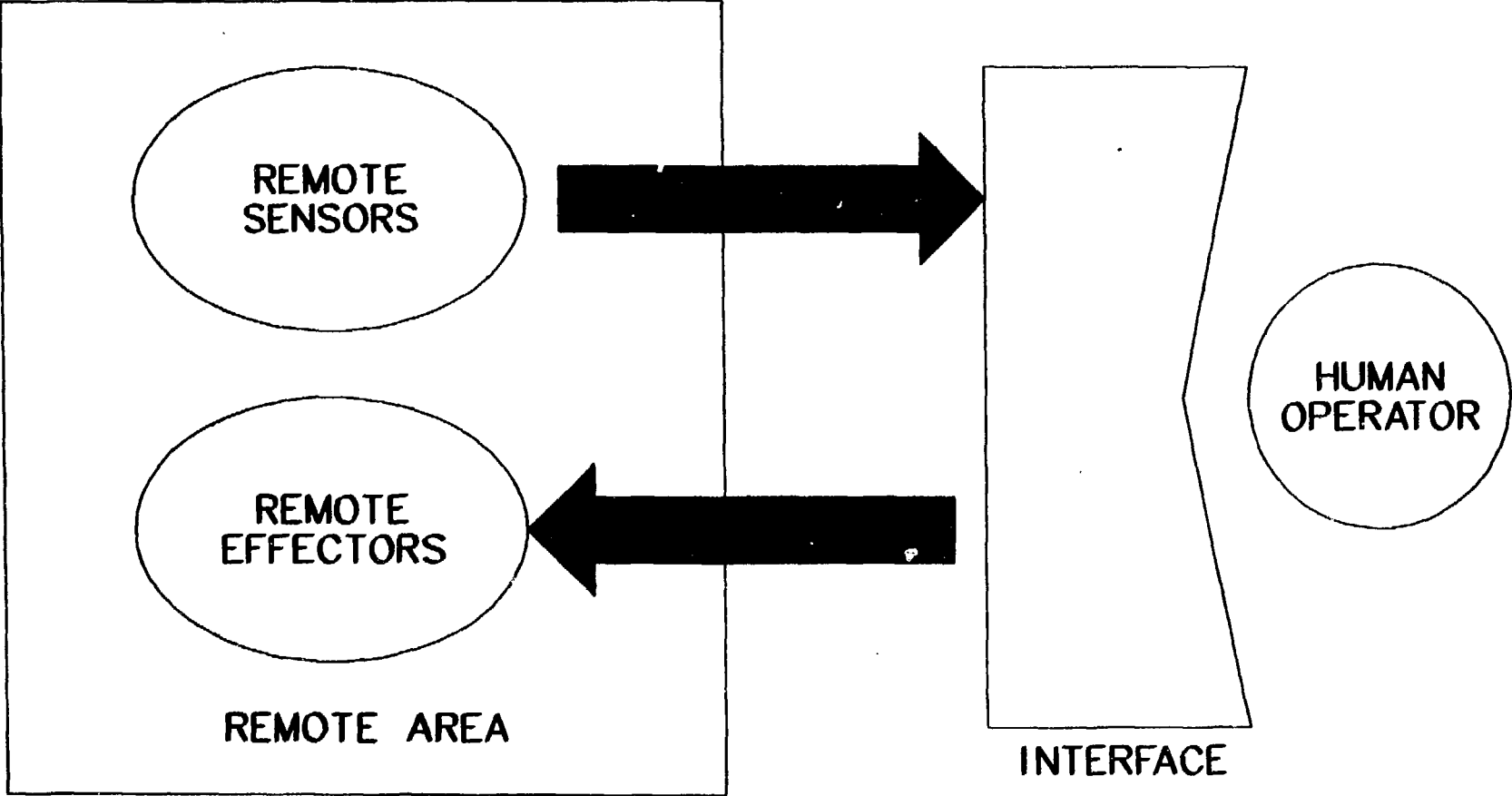
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- ◆ DISPLAYS:
 - TELEVISION
 - CRT DISPLAYS
 - FORCE REFLECTION
 - LOUDSPEAKER
 - DIALS, GAUGES, BELLS, ETC.
- ◆ CONTROLS FOR:
 - MANIPULATOR
 - TRANSPORTER
 - CAMERAS

**INTERFACE IS POINT OF CONTACT
BETWEEN HUMAN AND TELEOPERATOR**

INTERFACE ALLOWS INFORMATION TO FLOW TO AND FROM OPERATOR



IDEAL HUMAN-TELEOPERATOR INTERFACE MIGHT PROVIDE "TELEPRESENCE"

- ◆ **TELEPRESENCE: THE TRANSPARENT INTERFACE**
 - **FULL SPECTRUM SENSORY INPUTS/CONTROLS**
 - **DEXTRIOUS HUMAN-LIKE EFFECTORS**
 - **EXOSKELETAL CONTROLS**

**TELEPRESENCE WOULD PROVIDE COMPLETE
REPRODUCTION OF THE REMOTE SCENE**

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HOWEVER, EFFECTIVE TELEOPERATORS CAN BE BUILT WITHOUT TELEPRESENCE

- ◆ **MISSION-ORIENTED APPROACH**
 - **TASK ANALYSIS**
 - **TASK ALLOCATION**
 - **OPTIMAL MIX OF AUTOMATION/MANUAL CONTROL**
- ◆ **OPTIMAL ERGONOMIC DESIGN**
- ◆ **COST-EFFECTIVE DESIGN**

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TELEOPERATOR INTERFACE DEGRADES NORMAL HUMAN INPUTS

INPUTS USING TELEOPERATORS

◆ VISION: TELEVISION

- DEGRADED COLOR**
- LOSS OF STEREOSCOPIC CUES**
- LOSS OF RESOLUTION**
- UNNATURAL SCENE/END-EFFECTOR RELATIONSHIP**

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TELEOPERATOR INTERFACE DEGRADES NORMAL HUMAN INPUTS

INPUTS USING TELEOPERATORS

- ◆ **TOUCH/PROPRIOCEPTION: FORCE REFLECTION**
 - DEGRADED PERCEPTION OF WEIGHT, INERTIA
 - DEGRADED SENSE OF ARM POSITION
 - UNABLE TO FEEL TEXTURE

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TELEOPERATOR INTERFACE DEGRADES NORMAL HUMAN INPUTS

INPUTS USING TELEOPERATORS

- ◆ HEARING: MICROPHONE/SPEAKER
 - LOSS OF CUES FOR DIRECTION
 - DISTORTION

TELEOPERATOR INTERFACE DEGRADES OUTPUT MODES

OUTPUTS USING TELEOPERATORS

- ◆ REDUCED DEXTERITY**
- ◆ INCREASED FATIGUE**
- ◆ REDUCED CONTROL OF FORCES APPLIED**
- ◆ CONFUSING INPUT/OUTPUT RELATIONSHIPS**

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NEW TECHNOLOGY MAY IMPROVE HUMAN-MACHINE INTERFACES

- ◆ **M-2 DIGITAL CONTROL SYSTEM (ORNL)**
 - IMPROVED DEXTERITY, FORCE SENSITIVITY
 - FORCE SCALING
 - FULL-MASTER INDEXING

- ◆ **GENERALIZED MASTER CONTROLLER (JPL)**
 - MORE TRANSPARENT INTERFACE

- ◆ **HIGH DEFINITION TELEVISION (NHK)**
 - HIGHER QUALITY TELEVISION

- ◆ **STEREO TELEVISION (NOSC, UKAEA)**
 - IMPROVEMENTS IN STEREO SYSTEMS

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CURRENTLY AVAILABLE TECHNOLOGY CAN ALSO IMPROVE INTERFACES

- ◆ **VOICE INPUT/OUTPUT**
- ◆ **INTEGRATED CONTROLS/DISPLAYS**
- ◆ **ADVANCED COMPUTER GRAPHICS**
- ◆ **ERGONOMICS**

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- ◆ TELEPRESENCE IS IDEAL BUT NOT REQUIRED
- ◆ CURRENT INTERFACES DEGRADE NORMAL HUMAN INPUTS/OUTPUTS
- ◆ AVAILABLE AND DEVELOPING TECHNOLOGY CAN IMPROVE INTERFACES

SUMMARY: HUMAN-MACHINE INTERFACE IS NOT IDEAL, AND MAY BE IMPROVED UPON