3.1

Motion range, mechanical structure, and complexity of building the device are highly related attributes. Parallel devices typically have smaller motion range and are more complex to build, but they can provide higher force output and stiffness which are two of the three criteria mentioned by Massie and Salisbury. The first criteria, device transparency, is linked to the quality of the materials. Metal pieces that are precisely machined lead to a more transparent device with lower friction, but also the device becomes more complex to build.

3.2.

Highest force: The ETHZ2DOF2012 (ReHapticKnob) with a peak translational force of 1181N, followed by the Harvard3DOF1999 with a peak force of 500N

Highest torque: The Harvard3DOF 1999 with a peak torque of 550 Nm, followed by the MarquetteUniversity1DOF2013 (Haptic Theradrive) with a peak torque of 45 Nm

Largest translational workspace: The best way to determine the workspace size is to measure the volume or workspace area, but since this information is not available, we use Haptipedia's estimate which is based on the average workspace size along the translational dimension. With this measure, several devices fall in the Large (>60cm) category. The largest ones are the Virtuose 3D, the Phantom Premium 6DOF, and the Flying Phantom.

Smallest translational workspace: Given the same measure as above, the Immersion2DOF1998 (FEELit) and the UBC6DOF1997 (PowerMouse) have the smallest translational workspaces.

High force output and a large workspace: These include devices in the top right corner of the left plot (translational workspace vs. force). The TechnischeUniBerlin6DOF2004 (VISHARD10) is an example device that provides high force in a large workspace.

3.3

Typically, parallel and serial-parallel mechanisms provide a higher force output than serial mechanisms, but as you can see in the answer for 3.2, it is not an absolute rule. The Harvard3DOF1999 and the TechnischeUniBerlin6DOF2004 (VISHARD10) are serial devices but they use strong motors and hard links to provide a high peak force. Mechanisms that use a brake or are admittance type also provide high force output. The ETHZ2DOF2012 (ReHapticKnob) uses a brake and the HapticMaster is admittance-type.

3.4.

Below, we compare one pair of devices as an example.

MegLev Device (UHM6DOF2009):

- Body-device interconnection: Power-grasp but
- Motion range: Six degrees of freedom along the translational and rotational dimension. Small workspace of 5 cm * 5 cm * 5 cm along the translational dimensions and 60° * 60° *60° in the rotational space. It allows for precise wrist motion since there are no mechanical links.
- Mechanical structure: controversial since there are no mechanical links to perform a loop.
- Versatility: general-purpose, Butterfly Haptics (https://butterflyhaptics.com/) is a commercial version of this device.
- Unique features: yes, magnetic levitation
- Complexity of building: complex due to its unique mechanism and high degrees of freedom

WoodenHaptics:

- Body-device interconnection: power-grasp
- Motion range: arm motion along three translational dimensions of 20 cm * 20 cm *20 cm. Small to medium workspace. No rotational degrees of freedom.
- Mechanical structure: serial
- Versatility: general-purpose
- Unique features: none
- Complexity of building: low to medium as it can be created through DIY tools such as a laser cutter