Robots in the field, Part 1
(ME5286 Robotics, University of Minnesota)

Worth exploring…  https://www.automateshow.com

Selected videos and web sites that illustrate:

A) The state of the art in commercially available machines,
B) “Robots” and autonomous machines of interest,
C) “Far-out” machines, and
D) Recent thinking on the subject

All web site links have been updated as of Jan. 25, 2017

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Collaborative robots

- Robots don’t require protective cages
- Incorporate force and torque sensing in order to prevent injury to adjacent humans

Robots on BMW's Assembly Line

At BMW’s South Carolina plant, robots work side-by-side with human workers, making the assembly line more cost-effective and productive. See 3 minute video at:
https://www.asme.org/engineering-topics/media/automotive/video-robots-bmws-assembly-line

Also see article “Smart Robots Can Now Work Right Next to Auto Workers” (Sep-17-2013)
Collaborative robots

See for example Universal Robots
https://www.youtube.com/watch?v=UQj-lyZFEZI&list=PL0CpSfurQHiLISHh5kxEhtj11zgru5eeS (1:57)
https://www.youtube.com/watch?v=MktHBylJDNg (34 seconds)

Repeatability: +/- 0.1 mm / +/- 0.004 in (4 mil)

<table>
<thead>
<tr>
<th></th>
<th>UR3 robot arm</th>
<th>UR5 robot arm</th>
<th>UR10 robot arm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working radius</td>
<td>500 mm/19.7 ins</td>
<td>850 mm/33.5 ins</td>
<td>1300 mm/51.2 ins</td>
</tr>
<tr>
<td>Payload</td>
<td>3 kg/6.6 lbs</td>
<td>5 kg/11 lbs</td>
<td>10 kg/22 lbs</td>
</tr>
<tr>
<td>Weight</td>
<td>11 kg/24.3 lbs</td>
<td>18.4 kg/40.6 lbs</td>
<td>28.9 kg/63.7 lbs</td>
</tr>
<tr>
<td>Footprint</td>
<td>118 mm/4.6 ins</td>
<td>149 mm/5.9 ins</td>
<td>190 mm/7.5 ins</td>
</tr>
<tr>
<td>Axis</td>
<td>6 axis</td>
<td>6 axis</td>
<td>6 axis</td>
</tr>
</tbody>
</table>

For an interesting collage of robots across the spectrum …
- “The Most Awesome Robots (until 2015)” (37:11 minutes) see https://www.youtube.com/watch?v=S5AnWzjHtWA
  Nao from Aldebaran Robotics, Honda’s Asimo, Paul (drawing robot), Boston Dynamics’ Petman, Wildcat, LS3, Kokoro’s Actroid, NASA’s Rover and Festo’s Bionic Kangaroo

- “15 Most Advanced Robots Ever Invented” (7:55 minutes), see https://www.youtube.com/watch?v=tJf-dpaIdYY
Another collaborative robot...
Baxter cited in Time Magazine as #17 in:
“The 50 Best Inventions of the Year” (Nov. 1, 2012 issue)

• Price: About $25,000
• Compliant joints; programmed by manually moving arm through its task.
• See cover story at:

OR http://www.rethinkrobotics.com
and http://www.rethinkrobotics.com/collaborate/

For 3:23 minute video, see
https://www.youtube.com/watch?x-yt-ts=1421782837&x-yt-cl=84359240&v=gXOkWuSCkRI#t=20

Photo: David Yellen from IEEE Spectrum
And yet another “collaborative” robot

Kuka LBR iiwa robot

LBR stands for "Leichtbauroboter" (German for lightweight robot), “iiwa” for “Intelligent Industrial Work Assistant”.


https://www.youtube.com/watch?v=Dh36aVOIkJI (2:56 minutes)

And for another application of a Kuka machine (3:52 minutes) …
Kuka Robotics pits a world class ping pong player against the Kuka KR Agilus Robot, billed as one of the fastest production robots in the world with over 150 pick and place/minute.
Website for Match: https://www.youtube.com/watch?v=tIIJME8-au8

Revenge match: https://www.youtube.com/watch?v=lv6op2HHIuM

KR Agilus Promo Video: http://www.youtube.com/watch?v=nwupK0ljVWQ